Editorial

IT would be difficult to over estimate the importance to Australia of the Union Radio-Scientifique Internationale Tenth Assembly now being held in Sydney.

It is doubtful whether a more distinguished gathering of world famous scientists has been brought together anywhere in the past. To many of the 60 delegates, it has been a long trip from their own lands. The encouragement has been the opportunity to observe at first hand the achievements of our own countrymen in the realms of radio-physics, radio-astronomy and associated sciences.

That all those who attended have considered this journey worthwhile is a remarkable tribute to our land, so small in population and resources, but which, in a few years, has gained world recognition in the front rank of scientific research.

Sir Edward Appleton, whose name is for ever linked with pioneer work concerning the ionosphere, made a number of telling points in his opening day speech which we would do well to remember.

He emphasised that no longer could any pure research worker consider his achievements of no practical value — interesting facts which left the world no better off for their discovery. He stressed the point which, day by day, is becoming clearer to the layman, that the universe is a closely related, interlocked series of processes and reactions, each of which has an intimate bearing, no matter how small, on every other.

Almost every day, new fields of application and understanding flow from earlier, fundamental research. Sometimes this has lain neglected for years until development, often in an apparently unrelated field, has fitted it into the general pattern of modern knowledge.

Sir Edward instanced radio, which to the man in the street is mainly a method of bringing programs and entertainment over the air. But radio is now the means by which we send questions into outer space, and which is gradually bringing us answers, often startling and unbelievable, to change man's ideas of what lies beyond. And yet this technique of question and answer is but an inevitable growth of radar, in which pulses of radio energy are radiated toward a target to be reflected and received again bearing all kinds of information about distances, and the nature of what lies outside the earth.

No one can doubt that Australia has a great destiny to be built by her people — a destiny which may yet gain for her a key place in the world of the future. In the fields of industry and commerce the seeds of that destiny are comparatively easy to recognise, for the problems arising from them touch the average man more or less intimately. The work of the "back room" boys he sees less often.

But we need have no doubt that our own scientists and research workers are planting milestones on the road. We must hail them among other great Australians whose work and vision are building the nation.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

EDITOR
JOHN MOYLE
S.M.I.R.E. (Aust.)

TECHNICAL EDITOR
NEVILLE WILLIAMS
M.I.R.E. (Aust.)

TECHNICAL STAFF
RAYMOND HOWE
MAURICE FINDLAY
PHILIP WATSON

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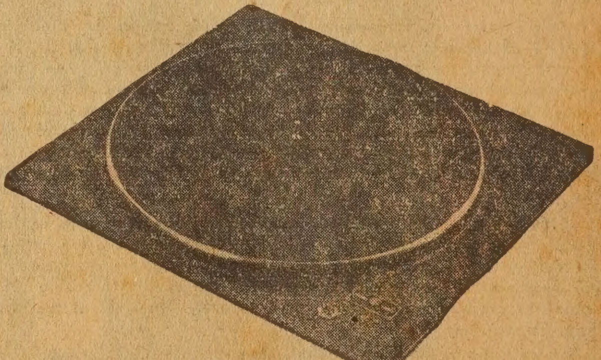

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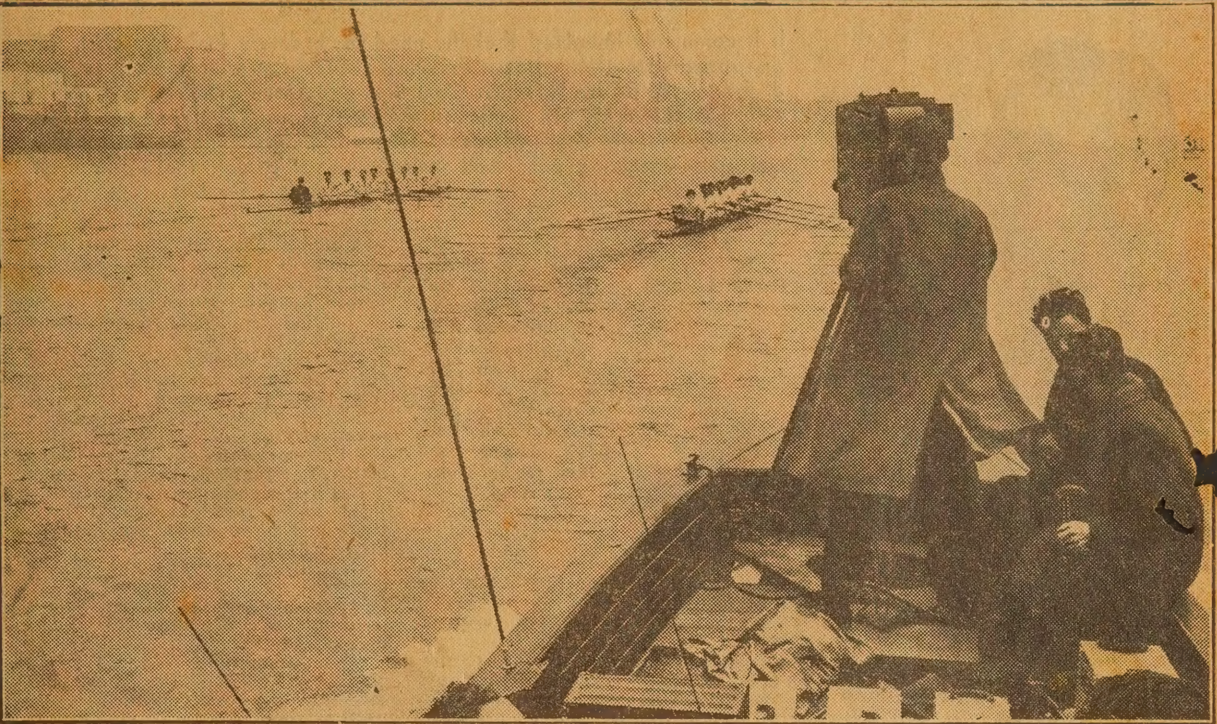
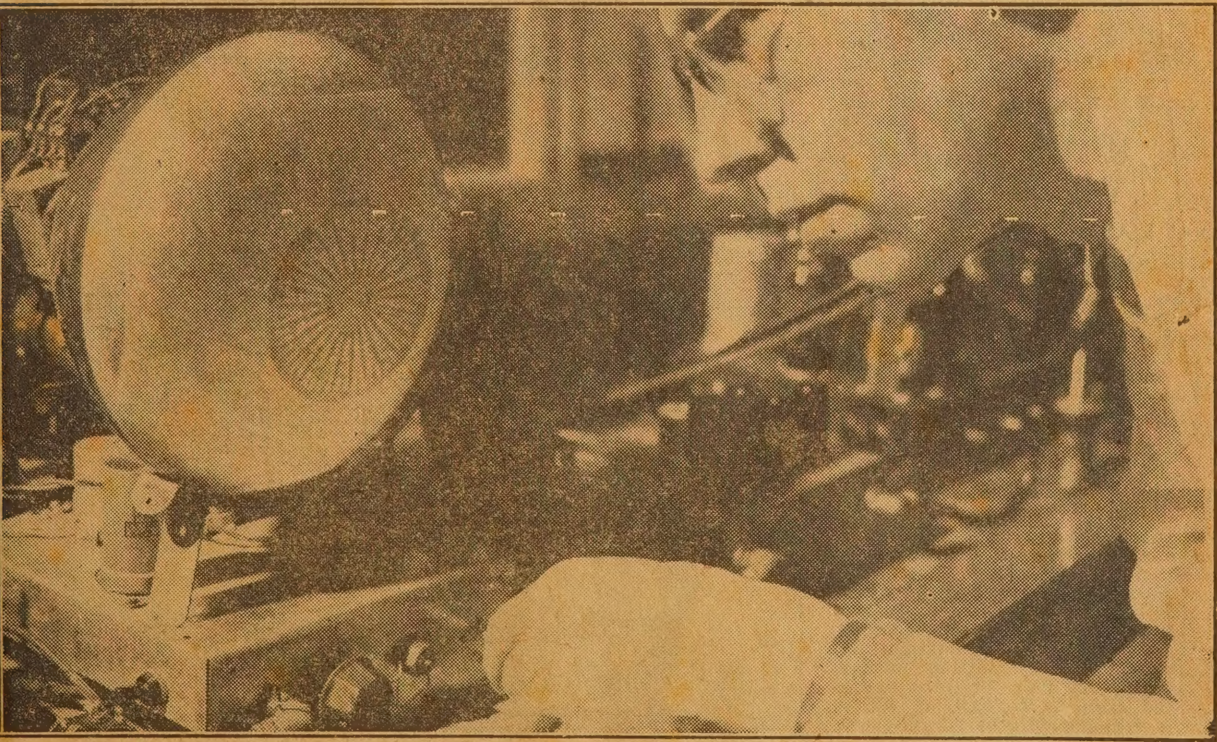
TWO NEW JOBS FOR TELEVISION



On the occasion of the recent Oxford-Cambridge boat race, the BBC made what is claimed to be the first public TV broadcast from a moving camera. A highly sensitive Marconi Image orthicon camera was used, with a microwave link to the shore. Special precautions had to be taken to prevent reflections from buildings &c., causing pulsation of the pictures.



Invented by Dr. Frank Roberts, Edinburgh-born electronic engineer, a new microscope which, half microscope, half television, can magnify living tissues up to 25,000 times. Backed by the Nuffield trust, the new instrument will soon begin counting the cells in the human brain, and will also portray the action of chemicals on living germs. Pattern on the screen is a diatom (the smallest living animal) magnified 2000 times.

ATOM POWER WILL NOT OUST COAL

It is commonly imagined that the need for ordinary fuels, like coal, will disappear when atomic power becomes available on a large scale. Doctor J. Bronowski, British National Coal Board research chief, doesn't agree with this idea at all. He points out that, with known sources of petroleum fast disappearing, coal will become the world's most vital source of raw materials—including oil! And irrespective of power, the world must have raw materials.

Dr. Bronowski, Director of Britain's National Coal Board's Research Establishemnt. He has gained the reputation from his articles and television talks of "the scientist who can talk English and likes to be understood."

SUCH a statement is specially significant to Britain, who still has vast quantities of coal as yet unmined. Australia, too, has been described recently as a country "sitting on a coal mine." Combined with her known resources of uranium, Australia may well be in a much happier position in regard to power and raw materials than has hitherto been the case.

If, as seems likely, atomic power is harnessed to generate electricity cheaply and in bulk the whole economy of the mining industry may well be changed. Power will be available to mine coal under difficult conditions and haul it over greater distances than can at present be considered. Or it may be processed on the field to produce raw materials ready for bulk distribution.

RAW MATERIAL

Looking ahead over possible developments Dr. J. Bronowski recently had this to say:

"Given an unlimited supply of atomic energy at some time in the future, coal will still be the richest form of raw material Great Britain will have.

"Do not let us just burn coal. Particularly do not let us burn it inefficiently. We must not just think of it as a source of power. Coal must be fully appreciated as our major raw material."

In this respect British research is well ahead of the rest of the world.

Foreign oil interests are generally concerned only in the production of oil from coal, which is merely the production of a second raw material. In fact the range of products directly obtainable from coal not only covers but extends beyond those currently obtained from petroleum, of which known supplies will be running out within the next 30-40 years.

Britain's own coal resources are thought to be good for at least another 1000 years, and though it is probable that power will come from atomic energy within the early part of that period nuclear physics is unlikely to be a source of materials, which will remain the real value of coal.

Explaining his vision of the future of coal, Dr. Bronowski said that just as no oil company will willingly retail crude oil, so raw coal should not be sold.

He suggested that the time might come when giant integrated plant akin to oil refineries would be erected in each coalfield. Coal in fine form would be pumped in from underground washeries along pipelines from each pit. Leaving the refineries would be solid fuels specially made for specific purposes, smokeless and leaving little ash.

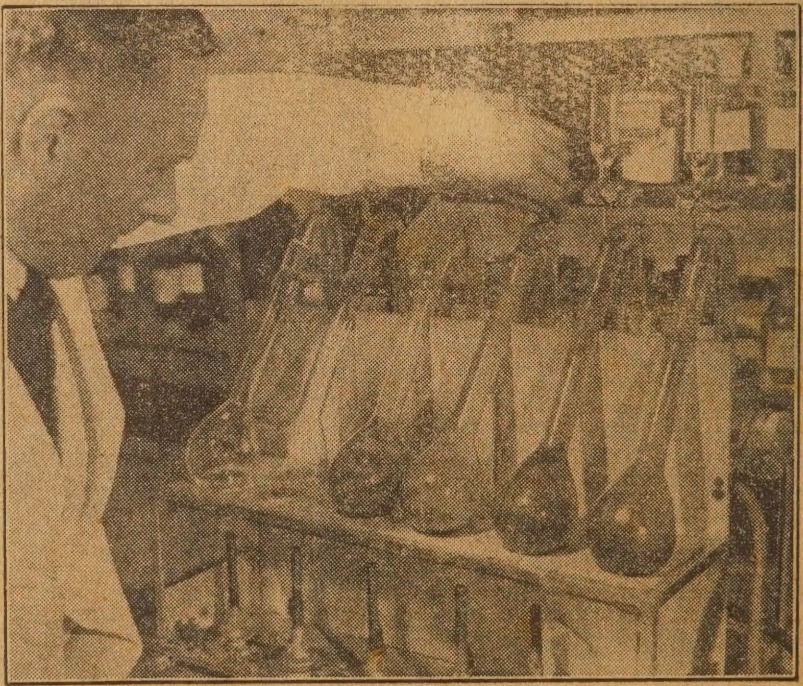
Fuel and lubricating oils, chemicals and bases for the plastic industries, drugs, materials for synthetic fibres like the current nylon and rayon groups and many products not yet known would all come from the integrated plant in prepared form.

Nothing would be wasted and the solid fuels supplied would be far more efficient than raw coal as burned now.

Dr. Bronowski thought that the underground gassification of coal, nowhere a successful process yet, was unlikely to become the general method of extraction.

More immediate research projects going on under Dr. Bronowski's direction are concerned with the 20-million tons of fine coals (about 10 pc of production) now put only to inferior use.

Its recovery would virtually end not only Britain's home shortages but export shortages as well; and the



Phosphorus in coal is a problem for the iron and steel industries. It enters the iron at the blast-furnace stage and can never be removed, making the steel brittle and damaging the furnaces themselves. A new technique developed by the Research Establishment allows the phosphorus content to be analysed in 2½ hours, against 2 days for the earlier methods.

RAW MATERIALS STILL ESSENTIAL

proportion of fines is tending to increase daily with the extension of mechanical coal-cutting.

Already solid fuels to careful specification are being made on a commercial scale from this dust.

A fast-selling smokeless fuel named phurnacite is being made on the scale of 100,000 tons a year. The Coal Board would make more of it, but, outside the laboratories of the Research Establishment, it is thought that this fine fuel can only be prepared from one natural type of South Wales coal.

INDUSTRIAL RESEARCH

The research people have now found a way of using many more types of coal for the same purpose, but the processes are not yet in production.

The iron and steel people are aware that the British supplies of coking coals will be running out in the next 10 or 15 years, but already the research workers have found ways of making other types of coal suitable for coking.

In this way a number of materials crises have been anticipated and already lump coal has been freed from export by the manufacture of specially-strong pitch-bound briquettes of the exact size preferred by locomotive firemen.

Not only are these fuels claimed to be better in every respect than raw coal, but they are made from the treated coal dust which would otherwise be wasted.

The full utilisation of coal in Britain cannot long be delayed. Already some pits are nearing 4000ft in depth and they will get progressively deeper. In some 20 years time they will all be nearing 5000ft, and such deep mining is bound to be expensive.

It cannot be economically sound unless every possible use is made of the products extracted as and with coal.

SULPHUR ALSO IMPORTANT

The sulphur problems of British industry would be ended if the seven million tons of sulphur now lost up the nation's chimneys each year could be saved. The United Kingdom's current demand is for about two million tons of sulphuric acid, which could be produced from 700,000 tons of sulphur, thus ten times the annual demand is being wasted each year.

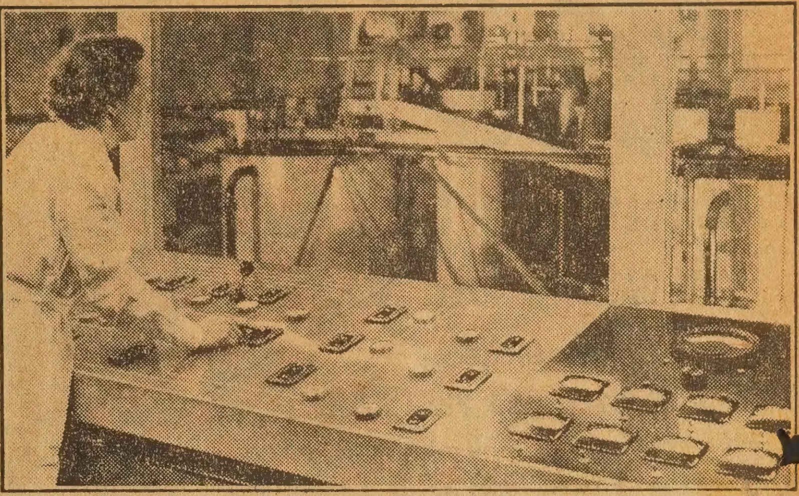
Most British coals contain 2 pc pyrite, which is about 50 pc sulphur. Research is now concerned with the removal of pyrite from dirt in the froth-flotation process and with the separation of the pyrite from the other unwanted constituents.

Thus from the 200-million tons of coal mined every year in Britain even a 30 pc average sulphur recovery would produce all the sulphuric acid needed by the United Kingdom.

Furthermore, sulphur in coal which is burned is not only useless but is the cause of most of the smoke pollution in the country.

Sulphur is not the only constituent of coal which, though valuable if extracted before burning, is normally

(Continued on Page 83)



The control, equipment of the pilot washer for fine coal at the NCB's central research establishment. This equipment is used as a demonstration to the coal industry on the degree of accurate control it will require in the near future for more specialised treatment of its products.

Froth flotation, used to recover the finest coal. Coal is brought in from the normal flotation plant suspended in water. The flotation agent is an oil, of which only very small quantities are required. Air is pumped in from underneath, the bubbles attach themselves to the coal and froth over it, leaving the dirt behind. The finest coal can be recovered this way, together with other important minerals.

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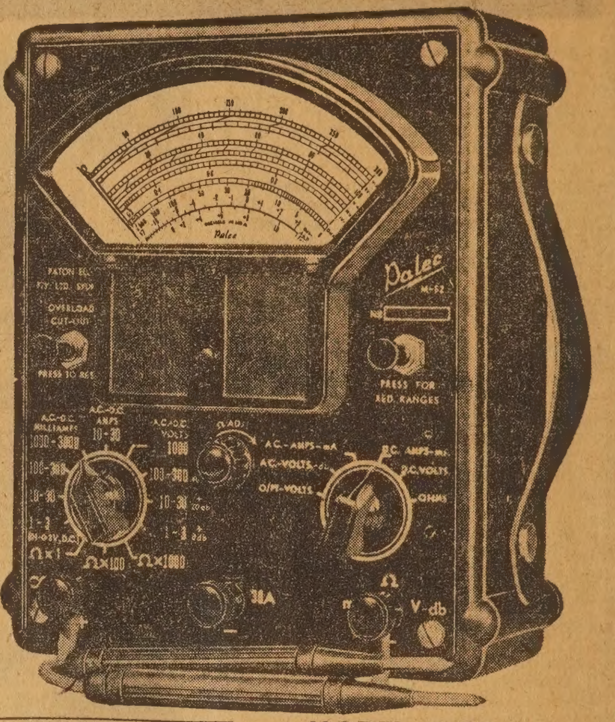

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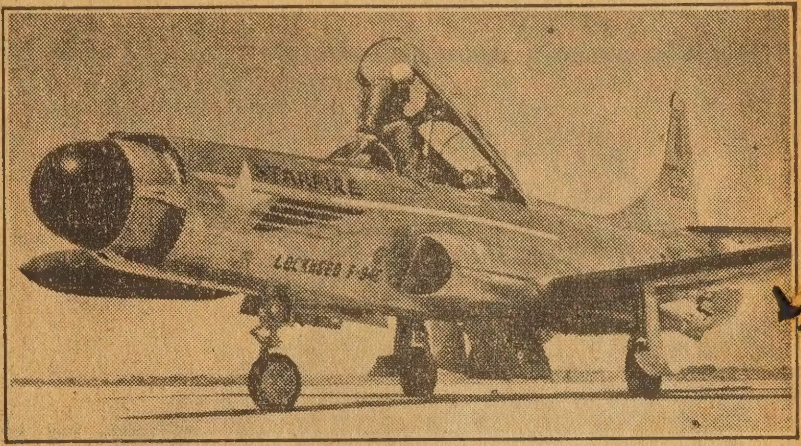
RADAR FLIES ROCKET FIGHTER

Details have now been released of America's newest jet warplane—the "Starfire". Designed to intercept and shoot down invading bombers, it is controlled almost entirely during attack by electronic radar equipment. The "Starfire" is now in production by Lockheed.



This shot of the new "Starfire" shows the tricycle undercarriage and the new rocket doors open to reveal the snouts of 24 rockets ranged right around the black dome which houses the radar aerial and equipment.

FIRST US fighting plane ever to have an all-rocket armament, the Lockheed F-94C, carries 24 rockets, the 2.75in size, housed in a ring of firing tubes around the nose.

Radar and specialised "brain-like" instruments enable the Starfire to spot the enemy miles away, lock on to the target, track, close, aim and open fire—all by itself, it was reported by Hall L. Hibbard, Lockheed vice-president and chief engineer.

The interceptor-type plane's specific mission is to knock out invading bombers.

The 94-C is one of the world's fastest climbing jet aeroplanes in ascending the 45,000ft bomber invasion lanes, Hibbard declared. Top speed is reported "more than 600 mph."

TERRIFIC POWER

The Starfire's jet engine produces a 6250lb thrust, without afterburner. With after-burner, a Lockheed-developed device which reignites jet exhaust, thrust rises appreciably to the greatest power of any single-engine plane in production.

Main duties of the Starfire's pilot and radar operator are to take the plane off, manoeuvre to the general target area as guided by ground radar watchers, switch on the "electronic crew" at the proper time, monitor operation of the piloting and rocket-control apparatus during the attack, and then land.

Like its predecessor F-94A and F-94B models, now on duty guarding US borders and major industrial cities, the F-94C is equipped to fly at night or in storms, find its target and return to base safely. Not all modern fighting planes are designed for all-weather, night-and-day work, it was pointed out.

Contributing to Starfire perfomance, Lockheed engineers said, are four special features:

1. A ribbon parachute, stowed in a tail compartment, can be released just as the ship lands, to halt it in a short space.
2. A thin wing, with a straight instead of swept-back contour, makes possible extremely high speeds without sacrifice of either stability during firing or manoeuvrabilty. The horizontal tail is swept back.
3. Placement of rockets as far forward as possible, in a ring around the radar nose, achieves maximum accuracy because of freedom from windstream turbulence.
4. For strength to take high speeds, the forward edges of Starfire single-spar wings are built of thick, curved slabs of metal, called integrally stiffened skins. These lighter-but-stronger wing pieces, which have both the skin and its stiffening ribs mechanicaly hollowed out of one piece of metal, eliminate hundreds of speed-reducing rivets. They save weight by eliminating numerous small parts.

Hibbard described the F-94C Starfire as one more step forward in the evolution of jet designs based on Lockheed's F-80, the original mass-produced jet aeroplane. Availability of the basic, proven F-80 design made it possible to produce the higher-performance Starfire many months sooner and at less cost than if design engineers had not had such a head-start.

Electronic innovations include the Westinghouse auto-pilot and Sperry Zero Reader. It is one of the few fighter-type planes equipped with ILS (instrument landing system) for low-visibility landings. Starfires pack 1200lb of electronics, compared to 168lb of radio in the Lockheed P-38 of World War II.

The Starfire is the first production aircraft to fly with the new Pratt and Whitney J-48-P-5 jet engine. Its after-burner provides extra power for rapid take-off and extra performance in battle.

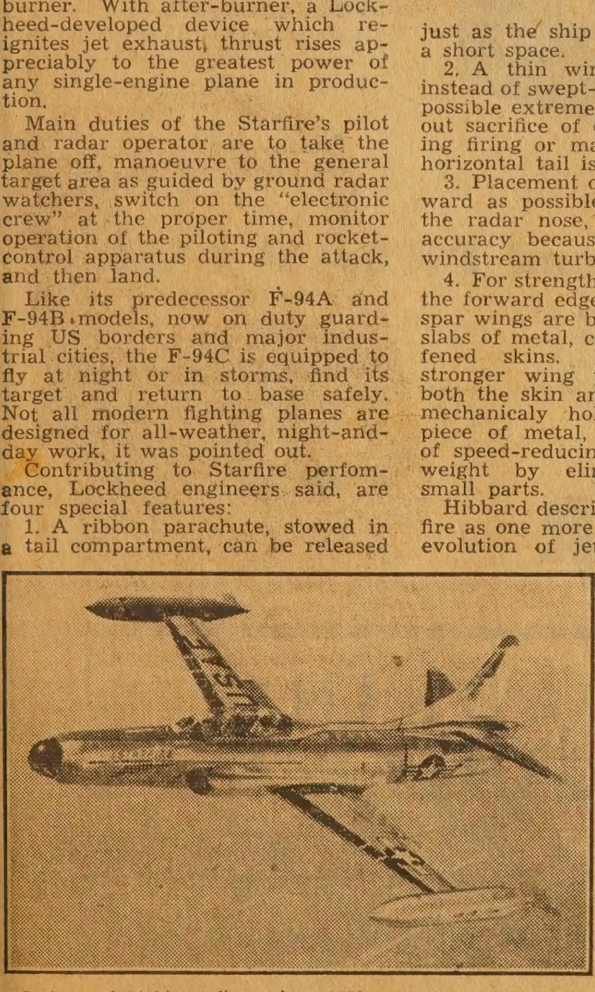
AUXILIARY JETS

For operation on extremely short fields, the plane can be lofted into the air more quickly than normally by two 1000lb-thrust RATO (rocket assisted take-off) packs under the fuselage.

Besides the main nose-rocket battery, new Starfires can carry additional firepower in underwing attachments, called pods, housing rockets. Bombs up to 1000-pounders or liquid-fire napalm tanks can be carried under the wings or in lieu of wingtip fuel tanks.

Seven feet longer and nearly 4000lb heavier than the F-80, the F94-C is the largest of the original Lockheed jet series. The statistics: Take-off weight, more than 20,000lb; length, 41ft 5in; wingspan, 37ft 6in; height, 13ft 7in.

The crew rides in a pressurised, temperature-controlled cockpit. Jettisonable canopy and ejection seats are provided.



The "Starfire" in flight with undercarriage retracted and rocket covers in position. Radar controls the plane right through the attack and breakaway manoeuvre and the crew may never see their "victim". They will, however, see the disappearance of its "pip" from the radar screen.

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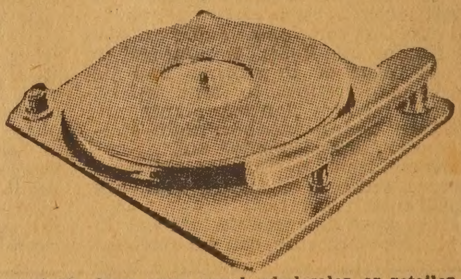

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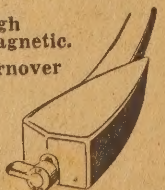

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GUIDED ROCKETS FLY 2,000 MPH

The time is not far off when British Industry will go into quantity production with high-speed, pilotless, missiles. This news, given by the Minister of Supply recently after visiting a missile firing range in Wales, comes at a time when an increasingly large section of the Aircraft Industry is at work on the super-priority task of developing these new weapons.

ROCKET-POWERED guided missiles have been developed which can travel at well over 2000 mph and can rise to heights far greater than any bomber is likely to reach for many years to come.

This performance is not in itself astonishing, because rockets have been fired at these speeds and heights for some years, but the great step forward is that these British missiles can also be guided very accurately on to a target.

They can be steered or, better still, can steer themselves, through the air with great accuracy. They are capable of rapidly altering course, as they would have to do to intercept aircraft taking evasive action.

VERY MANOEUVRABLE

In fact, they can twist and turn with four or five times the degree of manoeuvrability of a fighter aircraft.

This remarkable progress is the outcome of the combined work of a great number of people in science and industry. Much of the basic research has been done by the government's experimental establishments.

The results of this research have been made available to selected firms, who have been entrusted with the task of developing specific rocket weapons to fulfil various operational roles.

Almost every branch of industry is playing its part—aeronautics, engineering, electronics, plastics, chemistry and explosives. For this development work, new laboratories, firing ranges and other facilities have had to be provided on a considerable scale, and plans made for the factory capacity which will be required for production.

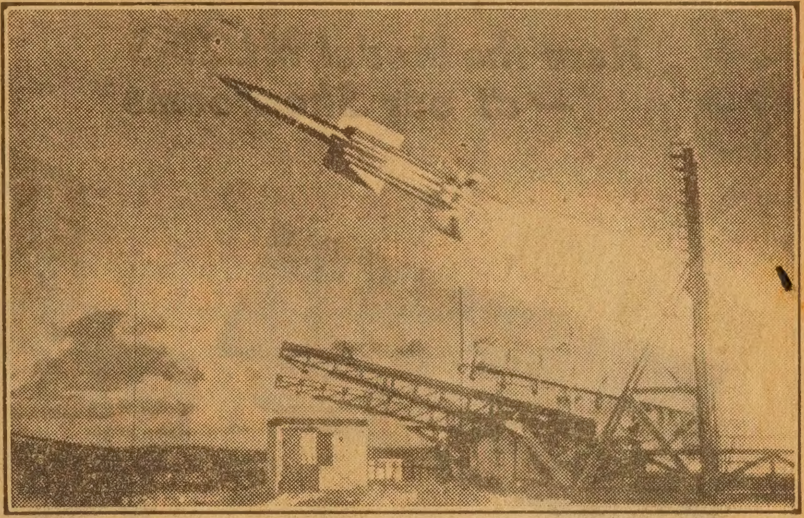
More than a hundred firms are now actively engaged on this many-sided enterprise, which is rapidly assuming the proportions of what can only be described as a new industry—the guided rocket industry.

The powerplants of some of the guided missiles of the future will be rocket motors so powerful that they will leave the jet engine behind in a "standing start." They will drive the missiles up to great altitudes, where gas turbines would be useless.

AUXILIARY POWER

A secondary task for the rocket motors is to give an auxiliary boost to the jet-powered aircraft for short periods on take-off, climb, or in combat.

Among the firms developing these motors are de Havilland Propellers, Bristol, Fairey and Armstrong-Siddeley. Practical work by these companies is well ahead; besides test flights already made, new and important motors are running on ground test-beds.



Flames pour from booster motors attached to its rear shaft as Britain's high-flying guided rocket, with a speed rating "well over" 2,000 miles an hour, takes off from a launching platform. The booster motors, which appear as tubes around the rocket's rear half, drop off when it reaches cruising speed and its own motors take over.

The rocket motor's great advantage over the jet is that it does not rely on oxygen from the atmosphere—it carries its own with it. Nor, like the propeller, does it need an atmosphere to push against; it gets its forward thrust from the reaction within the motor.

Because it carries its own oxygen with it, the rocket motor can operate at all altitudes, even beyond the stratosphere, where the air gets thinner and thinner with height.

PEFORMANCE IMPROVES

In fact, unlike the air-consuming gas turbine and piston engines, it is actually more efficient as the air gets thinner. This is why it is of such interest to would-be space travellers.

The disadvantage of the rocket motor is its extremely rapid fuel consumption. It uses its fuel most efficiently very high up, and at great speeds, and in these conditions it is an unrivalled powerplant for very high-speed flights.

The type of rocket motor now under development gives something like 200lb of thrust a second for each pound of fuel used—in other words, a motor giving 2000lb thrust uses up 600lb of fuel a minute.

The internal construction of rocket motors depends on the fuel they use. Early types used solid chemical fuels and were sophisticated versions of a small boy's firework rocket. But it was practically impossible to control the rate at which these rockets burned up their fuel, and their motors could not be cooled down.

In practice they rarely ran for more than a matter of seconds.

The rocket motors now being developed use liquid fuels. Unlike the solid fuel types, these have many of the flexible characteristics of any other type of powerplant—they can be cooled, and they can also be switched on or off quite easily, or run at a fraction of their full power.

The temperature inside the combustion chamber of a rocket motor is extremely high, but some kinds of motors are, relatively speaking, "cold." These use large quantities of a single simple liquid like hydrogen peroxide, which, when it is mixed with a catalyst, becomes a gas which burns at 500deg. C.

The so-called "hot rocket" has its combustion chamber at about 2000 deg. C or more. It burns two chemicals, one a fuel, the other an oxident (a chemical which is very rich in oxygen).

BASICALLY SIMPLE

The rocket motor is basically a simple device to operate. Its fuel is pumped into a combustion chamber along with the oxident, and is initially fired off by a high intensity spark plug, which starts the reaction. After that, like a gas-jet which has been lit, combustion is continuous.

The resultant gases expand tremendously, and these are pused out of a rear-facing nozzle at very high speed to give the rocket its forward urge.

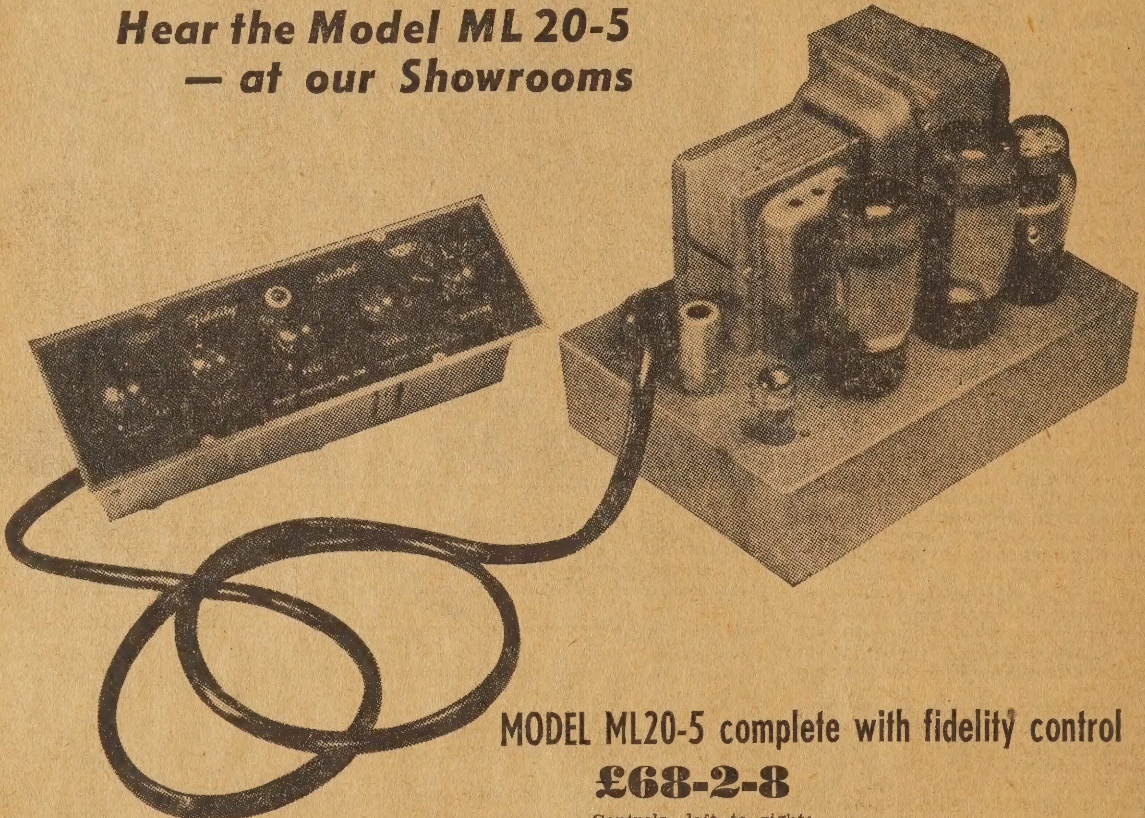
Scientists have tested a whole new

(Continued on Page 76)

FOR THE MUSIC LOVER . . .

Audio Engineers have designed a new series of amplifiers. The first model available has been designed to provide all the facilities necessary for realistic reproduction.

Hear the Model ML 20-5 — at our Showrooms



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- No. 5—Input selector, 5 position.
  - Position 1: Radio.
  - Position 2: LP records.
  - Position 3: 78 American records.
  - Position 4: 78 European records.
  - Position 5: Microphone.

Input voltage for pickup—20 millivolts.
General: Compensation for record characteristics built into control unit, independent control of bass and treble. Sharp cut off filter for minimising scratch on old records without affecting operation of bass and treble controls.

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BATTERY OPERATED WRIST WATCH

Hailed as a most important step in the science of horology, the Elgin Watch Co. of Chicago have announced the development of a wrist watch which will run for more than a year from a tiny replaceable battery. A simultaneous announcement was made by the Lip Watch Co., in France, which has joined forces with Elgin in an effort to produce the world's tiniest electric-powered mechanism.

Externally, it looks just like any other Elgin wrist watch. The "works" contain no mainspring, however, power coming from a microscopic electric motor and an inbuilt battery similar to the one shown alongside the watch.

SPURRED by the wide acceptance of conventional electric clocks, both AC and DC powered, the two companies have been quietly working on the design of an electric watch for many years. Such were the problems involved that the companies agreed to pool their research in an effort to achieve more rapid results.

The watch, which has now been shown by the Elgin Company, is development only and there is no certain indication at the moment as to when battery powered watches are likely to be released to the public. Likewise, ideas about price and their ultimate reliability are largely speculative.

The companies working on the battery-powered watch have had to break entirely new ground in research and their finding in "micro-electronics" may well be important in fields completely divorced from horology.

For example, they were faced with the problem of producing a motor delivering one seventy-five-millionth of a horsepower and providing it with a power take-off for the watch mechanism. It had to operate on such a minute amount of power that it would take 10,000,000 such motors to consume the power of a single 100-watt electric light globe.

Compared with this, even the smallest motors in ordinary electric clocks are giants and standard design and production ideas simply could not be scaled down sufficiently to encompass the new project.

REDUCED DIMENSIONS

For example, the magnet structure of an ordinary electric clock may have dimensions ranging around the inch mark but one to fit inside a watch, and still leave room for battery and gear train needed to be only the merest fraction of the size. And, electrically, its magnetic force would diminish roughly by the square of the dimensions.

The coil, too, needed to be similarly reduced, becoming probably the smallest practical coil ever to be wound. Experimental coils for the Elgin watch were slightly more than an eighth of an inch in diameter and about one-thirty-second of an inch long.

Yet they were wound with 3000 turns of insulated copper wire, one-sixth the diameter of human hair.

Said to be the finest insulated wire ever wound into a coil, it is so fine that it cannot normally be seen without the aid of a microscope. A pound of the wire, if unwound, would be 240 miles long.

The battery to power the watch represents another completely new field of research.

Since it must be expected to operate the watch for long periods, it had to exhibit long shelf life, quite apart from its ability to deliver the requisite current.

It needed to be hermetically sealed, also, since no fumes could be tolerated in the watch itself, particularly in proximity to the tiny motor.

For all that, the battery obviously had to be fairly cheap and not too difficult to replace, when replacements became necessary.

NEW CELL

Originally, attention was directed to improving the Ruben-type cell, as used in World War II instruments and in modern hearing aids.

The limitations of this approach soon became evident, however, and new research has resulted in a different type of battery, again said to be the smallest power-producing cell ever made. The size of the development cell can be gauged from the picture above.

Estimated cost of replacement batteries in the US has been set at 25 cents.

Such are the problems involved, that the Elgin Company does not expect to release a saleable unit inside two years at the very least, while many more years may elapse before the techniques have been sufficiently developed to allow its sale in price competition with spring-powered watches.

While an electric pocket watch would be a much simpler proposition, the company has decided to tackle the hard job outright. They reason that, once a successful wrist watch has been developed, the pocket watch will be no probelm at all, offering even greater precision and longer periods of operation before battery replacement becomes necessary.

The French model of the battery operated watch has been in operation for three years during which time it has undergone the particularly difficult tests of the National Chronometrical Observatory of Besancon. Out of eight tests at first-class certificate standard it easily passed seven.

Another watch which has been kept at a constant temperature is still accurate to within less than a second after several months of operation.

The astronomers at the observatory, used to carrying out a routine morning winding of the watches under test, were highly intrigued by the new watches which kept accurate time day after day without the need for attention.

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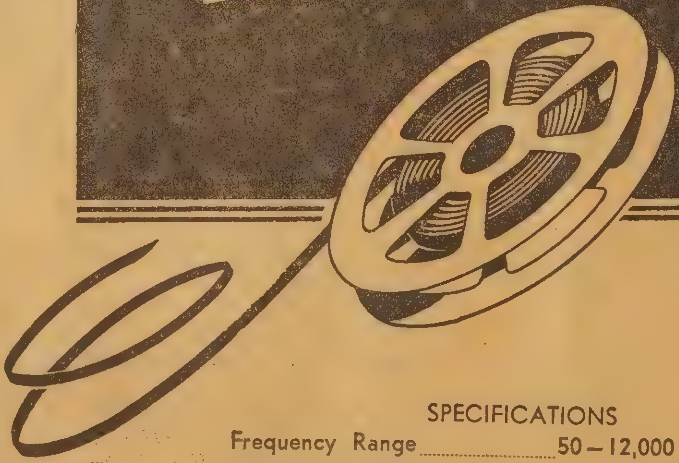

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AS I SEE IT—MODERN TRAVEL

When the twentieth century was born, the world was a comparatively leisurely place. True some express trains in Britain travelled at speeds of sixty miles per hour, but they did it safely on fenced-in lines. A few horseless carriages, only recently freed from the Red Flag Act which kept their speed down to five miles per hour, chugged along the roads; but the horse was still the normal method of road transport.

By PROFESSOR A. M. LOW

IN flying, a spectacular advance had not long been made. Santos Dumont had flown around the Eiffel Tower in his airship, winning a substantial prize by completing the journey of seven miles at a speed of 14 miles per hour.

At Lake Constance, Count Zeppelin had constructed a gigantic airship on new principles which reached a speed of 20 miles per hour.

A handful of enthusiasts—cranks many people called them—had been experimenting with gliders and even strange winged-machines powered by steam engines. No one really took them very seriously.

WELLS WAS WRONG!

You can judge the attitude of the average person by comparing it with that of H. G. Wells, who was no average man, but a trained scientist with a vivid imagination and a gift of foretelling the future which had made him famous.

He wrote: "I do not think it at all probable that aeronautics will ever come into play as a serious modification of transport and communication ..." this was in the first year of the century.

While young Mr. Wells was writing his book "Anticipations," from which the above quotation was taken, two young men in America called Wright, who had read the obituary of Lillienthal, killed while gliding, were producing a glider which was the first to be fitted with elevators.

It is now familiar history that this was the prelude to the construction of the first powered aeroplane in 1903. They covered 852ft in 59secs—a speed of very few miles per hour. Today there are aircraft capable of travelling 852ft in one second.

FLYING WAS ENOUGH

At the dawn of the century the mere fact of flight at all was sufficiently fantastic without worrying about miles an hour. Six years later flights were still being measured in yards rather than speed, and it was not until World War I that flying as a means of communication began to make real progress. The aeroplane entered the war as a fragile baby and emerged a sturdy adolescent.

That was only 30 years ago. It is still within the memory of millions of us that flying the Channel was considered so difficult that a prize of many thousands of pounds was offered.

Between the wars speed increased. The 100 mph that had seemed spectacular became 300 mph in 1929 and 400 mph in 1934. Always the target was set a little higher.

If World War I was notable for turning the aeroplane from an experimental device into an accepted means of travel, World War II was responsible for taking it to every part of the world.

Today there are thousands of aeroplanes capable of travelling around the world in as many days as Drake took years. Almost any part of the civilised world is less than 30 hours' journey from any other part.

That is some measure of the revolution that flying has made in transport, and yet we are only at the very beginning. Commercial aviation today is in about the same state as railway travel in 1870. Most of the routes have been pioneered, but consolidation has hardly begun.

MORE AIR TRAVEL

The second half of the century will see nothing as epoch-making as that first flight of the Wright Brothers, and perhaps there will be no multiplying of average speeds by 10 and 20, but there will be a spectacular increase in transport by air comparable to the increase in transport by road in the first 50 years of the century.

Before the century ends, perhaps the person who remembers travelling to Paris by train may be as unusual as the man who remembers horse buses is today. A new generation will be growing up who accept air transport as the usual method of travelling long distances.

When the century dawned motor transport was sufficiently advanced for thinking people to accept it as a permanent new feature of civilisation. In 1900 no fewer than 5000 new cars were registered in the USA. bringing the total up to 8000, but I doubt if even the pioneering owners of those 8000 imagined that by 1916 the annual production would be 1-million cars and that that figure would be doubled and then trebled in little more than a decade.

OWN YOUR OWN!

The real revolution in motoring has not been the increase in record speeds, so much as the development of manufacturing methods to the point where it is possible to consider the motor car as a normal possession of the ordinary man.

The second half of the century will obviously see a tapering-off in road speeds, because of the limitations imposed by roads themselves. The man who motors to his office in the last year of the century will be content with a car that can travel at no higher speed than the cars of today, although he will demand much greater economy, comfort and simplicity of control.

In the early years of this century the railway train was the accepted method of speedy and safe travel on land. In the last 50 years rail transport has matured, rather than developed.

The feverish construction of new lines has ended, although the world would be richer for many thousands

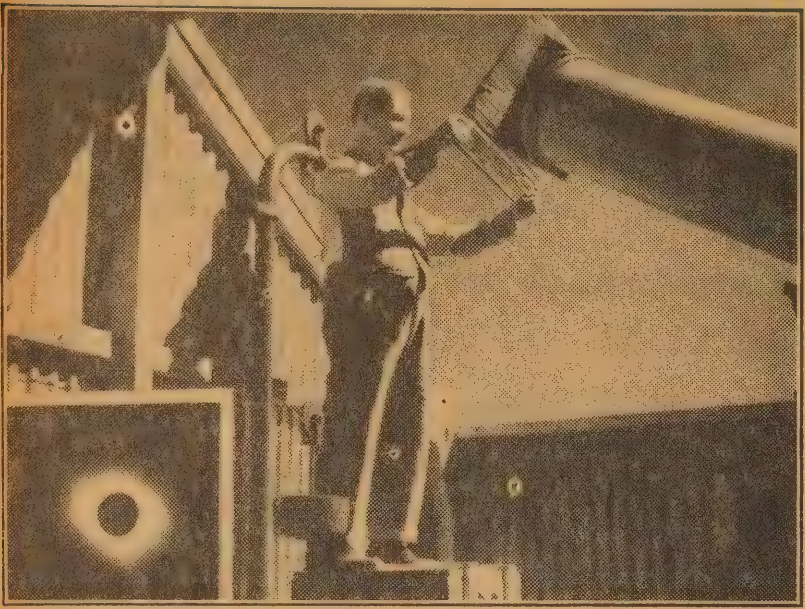
(Continued on Page 23)

A modern French electric loco, type 6.052, in service between Aix-Les-Bains and Roch-Sur-Foron. It is powered by a single phase current. (Photo by courtesy of French Embassy)

WHAT ARE THE STARS MADE OF?

In the light received from distant stars is the information scientists require to determine the temperatures, composition and nature of the gases which constitute the various stars. By means of more exact scientific equipment astronomers are beginning to verify or to explode previous conceptions about the constitution of the universe.

by Calvin Walters



Photographs of the sun, especially those taken during an eclipse, have proved enormously valuable in determining the source of its apparently limitless energy. Here Dr. Jackson is preparing to photograph starlight during the recent eclipse over Africa to test Einstein's theory concerning the bending of light rays.

MANY theories of the past have been deduced from observation throught telescopes and the application of knowledge about the behavior of elements and gases.

Originally it was believed that the sun was a liquid. This conception arose from the thought that if the mass of the sun was proportioned to the volume the result gave a density approximately one and a half times that of water.

There are other stars such as a dwarf star known as Krueger 60 which, proportioned on the same basis, has an average density greater than solid iron.

Another dwarf star known as the Companion of Sirius is so dense that it weighs about a ton to each cubic inch.

MASS, BRIGHTNESS

Now there is a certain relationship for gaseous stars which was discovered by Sir Arthur Eddington. He found that if the mass of a star was known its absolute brightness could be calculated. Conversely, if its brightness was known its mass could be calculated. These two factors apparently enable the scientist to describe the internal doings of a star.

It must be borne in mind that this formula of Dr. Eddington applied only to gaseous material and had no relation to liquid or solid matter.

But when Dr. Eddington tried the formula out on the sun and the denser Krueger 60 he found it worked and he suggested, therefore, that both these bodies must be of a gaseous nature.

It did not seem possible that any substance could be so tightly packed as the substance of the sun and still remain a gas and a mobile one at that. The clear logic of science, however, soon found the answer.

The explanation consists in removing some of the electrons which revolve around the atomic nucleus. It is best described as follows:

We will take an element which exists in abundance in the sun, namely iron. The atom of iron consists of a nucleus around which is revolving 26 electrons. These electrons move in orbits at varying distances from the central nucleus, and if we could magnify an iron atom so that its nucleus just became visible the outer orbit of electrons would be about six feet from the nucleus.

Now, say the scientists, there are only two electrons in this outer orbit and if they were removed the atom would be considerably smaller but would still be that of iron.

There are fourteen electrons in the next orbit. These can also be removed without altering the atom from one of iron. Remember that the nucleus is the predominant feature in determining the character of the atom and so long as this remains reasonably intact the atom would retain its characteristics.

SMALLER ATOMS

We have now reduced the size of the atom to a very great extent and it is believed that it would be possible to remove the eight electrons in the next orbit, leaving only the central nucleus and two electrons of the iron atom and yet retain the essential characteristics.

This is reducing the size of the atom to the irreducible minimum. It would be so small that millions of them could occupy a space previously occupied by the whole atom.

Consider the forces in the sun which could act to smash atoms in this manner.

The surface of the sun is about 10,000 degrees Fahrenheit. Its internal temperature is 15,000,000 degrees. All the elements of the sun, such as iron, copper, sodium, oxygen, helium and a host of others, are subjected to the enormous pressures and disintegrating effects of this high temperature.

In addition there is the enormous gravitational effect which creates tremendous pressures within the sun. Tremendous conglomerations of particles attract neighboring masses and head-on collisions occur which knock the shells of electrons from their orbits, reducing the atoms to such a size that the sun is a mass of emaciated atoms which require a much smaller space than normally. However, because they can still move, they can still be classed as a gas.

Such is the logic of science that, having shown that the sun is a gas and having the knowledge from experiment what happens to gases under varying degrees of pressures and temperatures, it was but a short step to the deduction that at a temperature of 15,000,000 degrees the gas of the sun will generate radiation in the form of x-rays.

To quote Dr. Eddington: "Crowded together within a cubic centimetre there are more than a quadrillion atoms, about twice as many free electrons and 20,600-trillion x-rays. The x-rays are travelling at the speed of light and the electrons at 10,000 miles a second. Most of the atoms are hydrogen, or, rather, since they have lost their satellite electrons, simply protons (hydrogen nuclei) travelling at 300 miles per second. Here and there will be heavier atoms such as iron lumbering along at 40 miles per second. I have told you the speeds and the state of congestion of the road and I will leave you to imagine the collisions."

RADIO WAVES

The x-rays within the sun may remain there for millions of years suffering progressive reduction of energy by repeated collisions with atoms, finally to escape in the form of a long-wave radiation of visible color.

The impetus which astronomy gains by the development of new apparatus is exemplified in the latest method of measuring the brightness of stars by means of the photo-electric cell, commonly known as a "magic eye."

Simply stated, a photo-electric cell is a device looking something like a radio valve but having a coating on the inside which is sensitive to light. When light falls on this coating it causes an electric current to flow. The strength of the current is proportional to the strength of the light, so that it can be said that the photo-electric cell virtually converts light waves into electrical impulses.

The impulses can be amplified in the same way as the impulses are amplified in a radio receiver.

The light which reaches us from a star is of a very low order of brightness and, as all we know about a star is learnt from its light, it is very important that we are able to get that light into as favorable an aspect as possible.

Now the eye is very insensitive to light variations below 25 pc, whereas the photo cell is sensitive to variations of 5 pc.

DIRECT COMPARISON

There are certain stars which have been the subject of much study. These are the variable stars, so-called because of their peculiarity of increasing and diminishing in brightness over regular intervals.

Some of these stars are twin stars revolving around each other, so that at regular intervals one star gets behind the other.

It has been previous knowledge that a certain faint star called AR Cassiopeiae was in the form of a main star with a very large companion which circled the main star in 6.1 days.

Much more than this was not known because the eye and photographic plates were insensitive to changes in the brightness of the star. The phototube, however, revealed an interesting story.

It was found that, when the smaller star of the two was in front of its companion, it reduced the amount of light coming from the pair by 13 pc. However, when the larger star was in front it reduced the total amount of light by only 3 pc.

With these figures it was only logical to assume that the smaller star was about one-quarter as bright as the larger.

Further information gained with the photo cell showed that the eclipse of each star by its companion were at unequal intervals, but always the same number of days. The eclipse of the main star by its companion (primary eclipse) occurred 2.3 days after the secondary eclipse. The secondary eclipse occurred 3.8 days after the primary.

This proves that the orbit of the companion star is an ellipse. Furnished with the above information, astronomers can calculate the dimensions of the stars from the relative duration of the eclipses and the total period of revolution.

Another useful function of the photo cell is the determination of the temperature of a star. Temperature of a star is never measured as such, because the light which reaches us has no measurable temperature. The temperature of a star is merely indicated by the color of the light received from it. The starlight becomes bluer the hotter the star is.

By means of the spectroscope it is possible to estimate the temperature, but the photo cell has opened up a more accurate method by means of a scale of comparisons.

For example, if a filter is placed over a photo cell so that light of only one color passes through, it is obvious that the photo cell will register the brightness of that color only in the light from the star. If now two colors are measured and their strength compared a good indication of the stars' temperature will be obtained.

"COLOR" OF HEAT

Let us take an example. We will choose yellow and blue for our two colors, because those are equally bright in the light from the sun if measured by a given photo cell.

Now it is known that the temperature of the sun is about 10,000 degrees, and we can take this as our starting point in building up a scale of star temperatures.

We now measure a hotter star

(Continued on Page 64).

An amazing star picture taken through the giant Mt. Palomar telescope. It shows the constellation of Monocerus, a chaotic mass of gas and dust which is reckoned to be 1000 light years from earth—six thousand million million miles away. The bright star in the upper centre is 10,000 times as bright as our sun.

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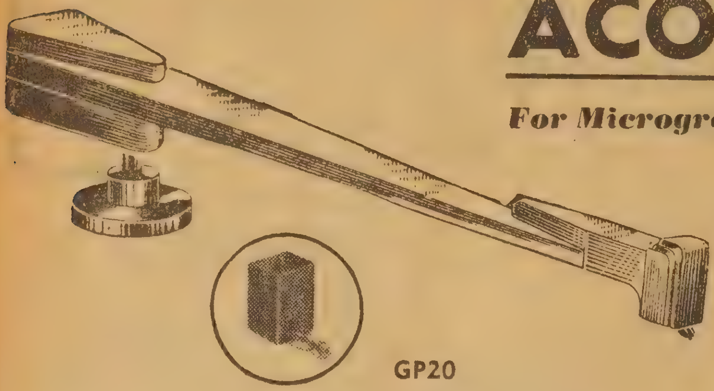

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Inset: The long-playing head. (GP-19LP) interchangeable with Standard Head (GP-19).

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GP19 head supplied as standard.

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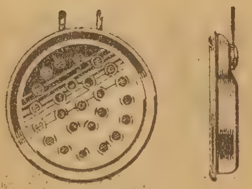

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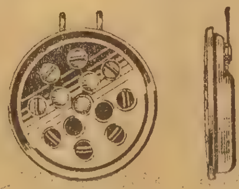

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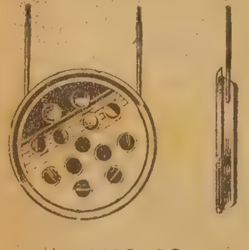

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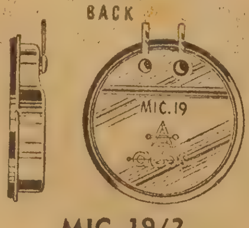

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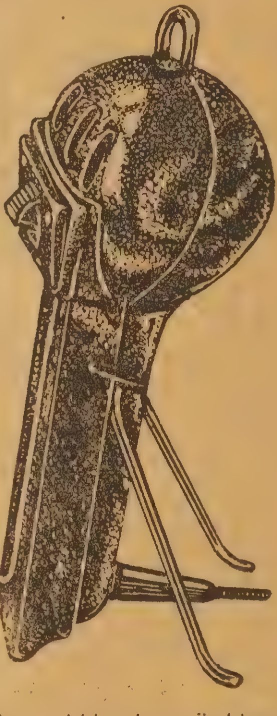

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Technical Review

A NEW TYPE OF LONG-DISTANCE V.H.F. PROPAGATION

Pre-conceived ideas on the behavior of VHF signals look like being rudely shattered by a recent report from America on a series of experiments in long distance transmission of signals in the 50 Mc band. Conducted over a period of several months, the experiments suggest that long range television may yet be possible, as well as extending the usefulness of other channels.

THE range of a VHF transmitter has hitherto been considered to be that of the distance of the radio horizon (somewhat beyond the optical horizon), this range being normally somewhat enhanced by the presence beyond the radio horizon of a diffracted wave. At times it is further considerably enhanced by refraction, reflection, or scattering from various forms of troposcopic irregularity, but such transmission is unpredictable and unreliable.

Propagation to long distances by way of the ionosphere has not been thought possible on VHF because — except at certain times for the lower VHF's only — the ionisation of the layers never reaches a value such as is necessary for the complete refraction of such high frequencies, and the waves are, therefore, not returned to earth, but penetrate the ionosphere altogether.

The American report tells of an experiment conducted over a path 774 miles long, the transmitter being at Cedar Rapids, Iowa, and the receiver at Sterling, Virginia. The frequency used was 48.8 Mc, and the type of emission, though not mentioned, was presumably continuous wave.

EXPERIMENT DETAILS

A power of 23 Kw was fed to a rhombic transmitting aerial with a main lobe whose maximum was at an elevation of seven degrees. With such a high gain aerial the effective radiated power in the direction of the receiver would be very high.

Signals were received at all times of the day and night and during the course of the experiment (which lasted for several months) there was never any failure in reception due to propagation effects.

The waves arrived at the receiver after travelling by way of the lower part of the ionosphere, the receiver signal power consisting of energy that was "scattered" downward from that region. No refraction process was involved, the energy scattered downward toward the receiver being but a small proportion of that incident on the layer.

There was rapid fading on the received signal, which was accompanied at all times of the day by random heterodyne whistles caused by meteors, and coincident with the occurrence of such a whistle there was often an abrupt increase in signal strength, due, no doubt, to reflection of energy from the ionised meteor trail.

The received signal was automatically recorded, and from the records the hourly average of signal level was obtained and a field strength graph plotted giving the hourly median values for a particular month. It would appear from this graph that the received signal strength was, having regard to the high radiated power, very low, and not to be compared with what would be obtained over such a distance from a wave returned from the ionosphere by the normal refractive process.

The mechanism of propagation is, in fact, shown to be that of scattering from irregularities in the electronic distribution (attributable to turbulences) which permanently exist in the lower part of the ionosphere, and it would not be expected in these circumstances that the signal strength would be other than low in relation to the power radiated. But the experiment is important in proving that such a new type of propagation is possible.

(Continued on Page 83)

7-YEAR-OLD PASSES "HAM" TEST

Leonard Ross 7, passed the F.C.C. test for a radio operator's licence on July 23rd this year, with a score of 85, to gain a Novice class permit. He correctly answered questions like "What is meant by parasitic oscillation?"

AUSTRALIA'S FINEST SELECTION OF

Cocktail and Radiogram Cabinets

MODEL 508

Slade's Radio Pty. Ltd.

Makes available to radio dealers and home constructors a full range of cocktail and radiogram cabinets. Made from best quality maple and Italian walnut veneers, finished with a brilliant piano finish.

MODEL 508

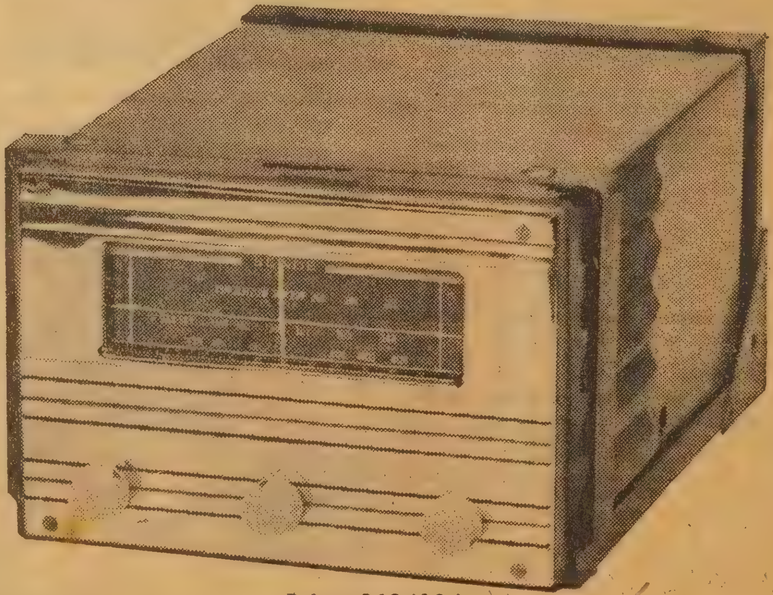
Model 508 is suitable for all types of record changers.

Slade's Radio Pty. Ltd. proudly present their most astounding achievement in 30 years

SLADE'S DUAL CAR AND HOME RADIO

The Slade Dual Car and Home Radio operates from 6 volt, 12 volt, or 240 A.C. Transferred from car to home use in 30 seconds.

Radically new circuits incorporated in its design guarantee it will outperform any other car radio in Australia.



Price £49/10/-

Can be seen at Radio Despatch, Wembley House, 841 George St., Sydney, Lavis Radio, Elizabeth St., Sydney and Wollongong.

South Australian distributor: L. Cockburn, 164 Gover St., North Adelaide, S.A.

SLADE'S RADIO PTY. LTD.

LANG ST., CROYDON, NSW.

TEL. UJ5381-UJ5382

Established 30 years

RADIO CONTROL FOR PENNSYLVANIA TURNPIKE

VHF and UHF radio systems make a substantial contribution to the operating success of the Pennsylvanian Turnpike—the high speed motor road stretching from the Ohio border to Philadelphia. Services cover traffic control, teletype, administration and personal messages for highway travellers.

THE turnpike, administered by a special commission is intended to carry high speed cross-country motor traffic. It is specially surfaced and is free of normal intersections and resulting traffic hazards. Normal speed limit is 70 mph.

All expenses of operating the highway are met by a system of tolls.

Experience in operating the turnpike has shown the necessity for an efficient radio communication system between all interchange and maintenance buildings, and with mobile patrols along the length of the highway. Typical jobs which the radio system handles are:

(1) Many motorists miscalculate and run out of gasoline. Their cars must be got moving as quickly as possible to avoid congestion and possible traffic hazards. Other cars fail to stand up to long runs at excessive speeds and burn out bearings. (The writer adds, as an afterthought, that Fords, Plymouths and Chevs. give least trouble in this respect.)

(2) Sudden icing or the formation of snowdrifts may require urgent attention from cinder trucks or snow ploughs, while drivers and patrol cars must be warned immediately against dangerous driving conditions.

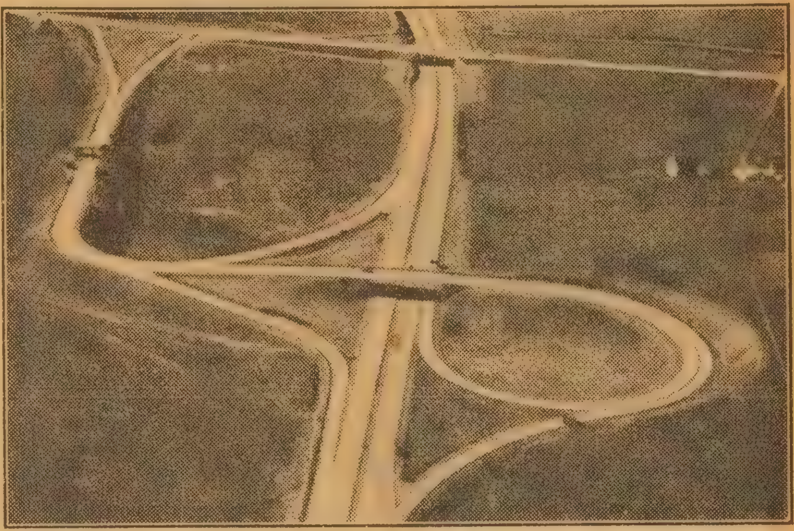
(3) Police action can be taken to halt cars travelling at excessive speeds—frequently around 100 mph—while more serious trouble has also been encountered between rival trucking drivers.

(4) Simple personal messages. lost property, &c., can be dealt with speedily over the voice channels.

(5) Ambulance crews are stationed at maintenance buildings and can be called out with a minimum of delay, in case of accident.

(6) Routine surface maintenance and repair are handled by mobile crews using radio control. Locations are pin-pointed by a system of number code signals and 1-10th mile markers along the highway.

The original radio installation went into service a year after the opening of the turnpike in 1940.



A view from the air of a typical interchange. The special system of cross-overs allows a vehicle to enter and leave the turnpike without cutting across the path of oncoming vehicles.

Built by RCA, the system used 116 and 119 Mc stations for the 160-mile end-to-end coverage of the highway, with equipment on the 30-40 Mc band for communication with patrol vehicles.

An FCC ruling forced a temporary change in frequency a little later but the installation has now been completely redesigned, coincident with the extension of the highway to Ohio and Philadelphia.

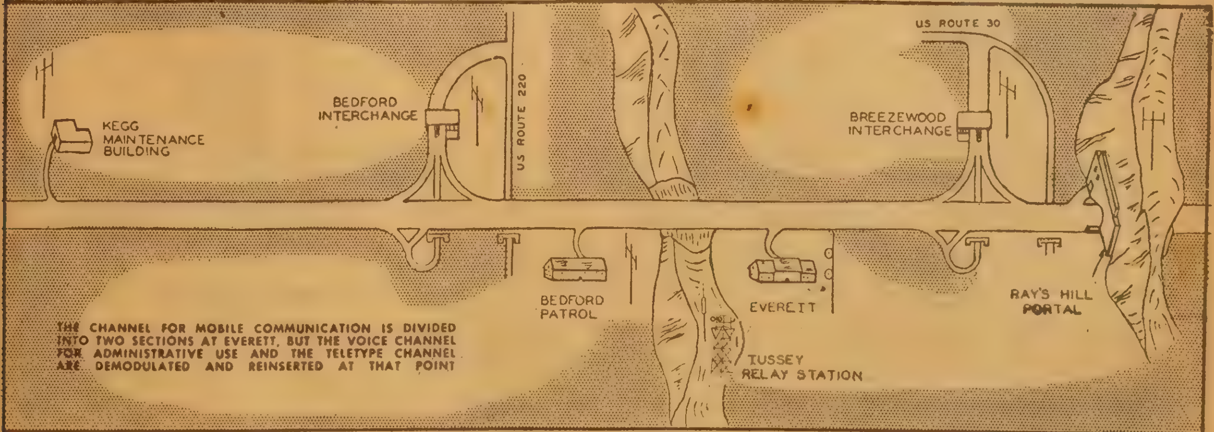
The highway has been cut in half, from the radio point of view, on the assumption that messages concerning vehicles or maintenance at one end of the highway will not necessarily concern personnel at the remote end. Traffic can, however, be fed right through the system if required.

There are now two terminal stations, thirteen relay stations and two maintenance stations, all with equipment on 953 and 960 Mc. This operates in conjunction with highly directional aerials mounted on lattice towers and handles all "through" traffic from end to end of the highway.

Each relay station has, in addition, a receiver on 155 Mc and a transmitter on 159 odd Mc to handle signals from moving vehicles or from fixed stations along the highway.

The system is so arranged that administrative calls are routed directly along the UHF link via the relay stations and the directional aerial systems.

(Continued on Page 83)


US ROUTE 30
BEDFORD INTERCHANGE
KEGG MAINTENANCE BUILDING
US ROUTE 220
BREEZEWOOD INTERCHANGE
BEDFORD PATROL
EVERETT
RAY'S HILL PORTAL
TUSSEY RELAY STATION
THE CHANNEL FOR MOBILE COMMUNICATION IS DIVIDED INTO TWO SECTIONS AT EVERETT, BUT THE VOICE CHANNEL FOR ADMINISTRATIVE USE AND THE TELETYPE CHANNEL ARE DEMODULATED AND REINSERTED AT THAT POINT

Illustrating diagramatically a small section in the centre of the highway, including the half-way terminal at Everett. Note the VHF installations (shown as three-element arrays) at maintenance, patrol and interchange stations.

SOLVE YOUR PROBLEMS WITH TAYLOR TEST EQUIPMENT

MODEL 47A-P

MUTUAL CONDUCTANCE VALVE AND MULTITESTER

MULTITESTER RANGES. 1000 ohms per volt A.C.-D.C.

D.C. Volts	D.C. Current	A.C. Volts	Resistance
0-120 m.V.	0-0.6 mA	0-3	0.5-22.5-1000 ohms.
0-3	0-6 mA	0-15	50-2250-100,000 ohms.
0-15	0-30 mA	0-150	x 500-22,500-1 megohm.
0-150	0-150 mA	0-300	x 5000-225,000-10 Megohms.
0-300	0-1.5 Amps	0-600	
0-600			x with external battery.

Fitted with large direct reading meter with illuminated dial and OVERLOAD PROTECTION. Tests over 2000 American English and Continental valves including latest types. Filament volts range from 1.1 volts to 117 volts. Filament continuity and element shorts shown directly on meter. Cathode leakage read in megohms The instrument is housed in a solid oak carrying case and supplied with comprehensive instruction manual. Also available as valve tester minus multitester ranges—Model 45 A-S.

IMMEDIATE DELIVERY

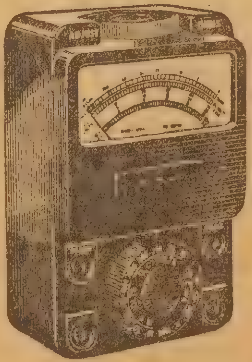
MODEL 75A

RANGES 20,000 ohms per Volt A.C.—D.C.

D.C. Volts	A.C. Volts	A.C.-D.C. Current	Decibels	Resistance
0—0.1	0—1	0—50 uA	—30 to —5	1—50—10,000 ohms
0—2.5	0—2.5	0—5 mA	—22 to +3	1000—50,000—10 Megohms
0—10	0—10	0—50 mA	—10 to +15	*10,000—500,000—100 Megohms
0—50	0—50	0—500 mA	+4 to +29	
0—250	0—250	0—5 Amps	+18 to +43	*With external battery.
0—1000	0—1000		+30 to +55	

This is a robust 20,000 ohms per volt 50 range universal multimeter designed for accuracy and stability. Fitted into an attractive case, the meter is provided with instantaneous OVERLOAD PROTECTION. The clear, easy to read scale has a length of 4 inches. An internal buzzer is provided for quick continuity tests. Complete with test leads.

MODEL 120A POCKET MULTIMETER



RANGES 1000 ohms per volt A.C.—D.C.

D.C. Volts	D.C. mA	A.C. Volts	Resistance
0—0.25	0—1	0—10	0.5—20—2000 ohms
0—10	0—10	0—50	50—2000—200,000 ohms
0—50	0—50	0—250	*500—20,000—2 Megohms
0—250	0—500	0—500	*5000—200,000—20 Megohms
0—500		0—1000	
0—1000		0—2500	*With external battery.
0—2500			

This is an accurate pocket size instrument using a robust, sensitive meter movement fitted with instantaneous OVERLOAD PROTECTION and is housed in a high grade moulded case. All resistors used for voltage and current ranges are adjusted to an accuracy of 1%. Supplied complete with test leads.

DIMENSIONS: 4⅞" x 3⅛" x 2"

Australian Distributors:

JACOBY MITCHELL & CO. PTY. LTD.

BX3446 (5 lines)

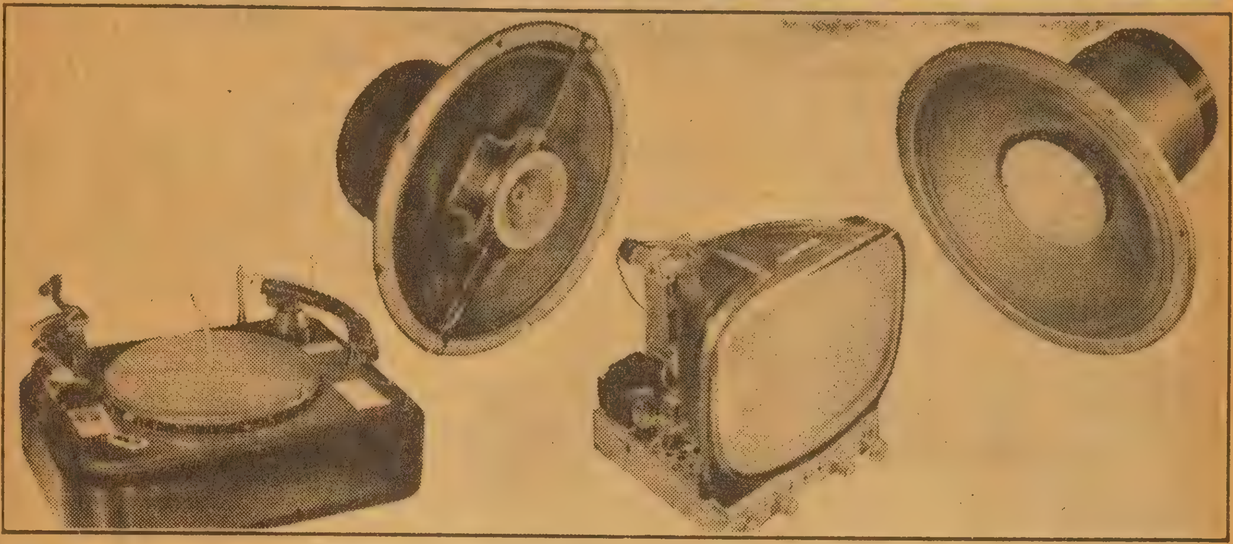
Sales and Showrooms, 277 Clarence Street, Sydney.

Taylor
Best for
TEST EQUIPMENT

SA: GERARD & GOODMAN LTD., 192-196 Rundle St., Adelaide.
Queensland: CHANDLERS PTY. LTD., Cnr. Albert & Charlotte Sts., Brisbane.
Victoria: J. H. MAGRATH & CO., 208 Little Lonsdale St., Melbourne.
NSW: JOHN MARTIN PTY. LTD., 116 Clarence St., Sydney.

Manufactured by:—TAYLOR ELECTRICAL INSTRUMENTS LTD., GREAT BRITAIN

STROMBERG BIDS FOR U.S. CUSTOM MARKET



Four of the units available in the Stromberg "Custom Four Hundred" line: Universal record changer with variable reluctance cartridges; 12-inch twin unit 32-watt speaker; television chassis adaptable for the UHF bands; 15-inch, 40-watt coaxial speaker.

Emphasising our remarks, last month, about the volume of "custom-built" radio business in the US, the Stromberg-Carlson Co. has come to light at the Chicago Audio Fair with a complete new line of matched, wide-range, high-fidelity audio equipment.

CALLED the "Custom Four Hundred," it is a complete assemblage of units, the quality of which leaves nothing to be desired by the audio enthusiast.

The "Custom Four Hundred" line is notable in that, perhaps for the first time, a major manufacturer has made available all his accomplishments in audio engineering as a flexible, custom-made group that can be acquired in whole or in part, with or without matching cabinets.

It is certainly the only complete, matched line of high quality audio equipment offered in the American market by one manufacturer today.

UNITS AVAILABLE

A short descriptionn of each unit follows:

FM-AM TUNER: Frequency response: 20 to 20,000 cycles, flat within 1½db on FM; to 7500 cycles, within plus-minus 3 db. on AM. Sensitivity, 5 microvolts. Power, 3 volts output across 25,000 ohm load at less than 1 pc total harmonic distortion.

AMPLIFIER: 10 watts of power at less than 1 pc total harmonic distortion. Frequency response, 20 to 20,000 cycles, plus-minus 0.5 db, 7 tion input selector, treble base and volume controls, power switch.

DE LUXE AMPLIFIER: 25 watts of power at less than 2 pc total harmonic distortion. (20 watts less than 1 pc). Frequency response, 20 to 20,000 cycles, plus-minus 0.5 db, 7 position input selector. Treble, bass, frequency and volume controls mounted on separate pre-amplifier as shown.

CHANGER: Garrard 3-speed automatic changer for 7in, 10in, and 12in records, with jewel-mounted pickup, muting switch, variable reluctance Pickering cartridges and automatic stop.

12in SPEAKER: Handles 32 watts. Frequency response 30 to 15,000 cycles, co-axial, 100 degree distribution, 20oz Alnico-V magnet for low frequency, 12oz Alnico-111 for high frequency, impedance 8 ohms.

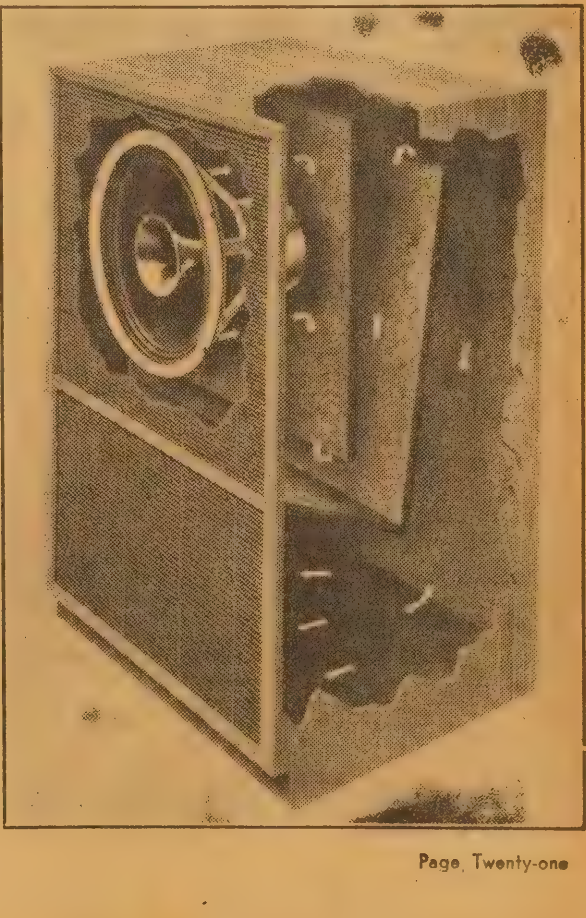
TELEVISION CHASSIS: Stromberg-Carlson Panoramic Vision Chassis with cylindrical-shaped 21in kinescope. Automatic focus, strip tuner adaptable to ultra high frequency channels.

15in SPEAKER: Handles 40 watts. Frequency response, 30 to 16,500 cycles, co-axial, 90 degree distribution, 7lb 8oz Alnico-V magnet, impedance, 16 ohms.

* * *

THE STROMBERG - CARLSON EXPONENTIAL ACOUSTICAL LABYRINTH: Exclusively a Stromberg-Carlson feature, this is a patented device that absorbs unwanted

Continued on next page



Cut-away view of the speaker cabinet which is styled to match the rest of the cabinet work (see overleaf). The cabinet is lined internally with absorbent material and also employs absorbent partitions which provide a measure of horn loading for the speaker at the bass end.

TELEPHONES: JA2877, JA2878 **FERGUSON LANE, CHATSWOOD**

STANDARD FERGUSON RANGE

For Output Transformers see other ad in this issue

RECEIVER POWER TRANSFORMERS

CODE No.	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS	RETAIL PRICE
PF185	240	150	30	6.3V/2A	47/9
PF299	240	285	40	6.3V/2A, 5V/2A	47/9
PF300	240	325	40	6.3V/2A, 5V/2A	49/5
PF201	240	225	50	6.3V/2A	48/7
PF151	200, 230, 240	285	60	6.3V/2A, 5V/2A	57/9
PF166	200, 230, 240	325	60	6.3V/2A, 5V/2A	58/9
PF165	200, 230, 240	385	60	6.3V/2A, 5V/2A	63/4
PF170	200, 230, 240	285	80	6.3V/2A, 6.3V/2A, 5V/2A	66/2
PF169	200, 230, 240	325	80	6.3V/2A, 6.3V/2A, 5V/2A	67/9
PF168	200, 230, 240	385	80	6.3V/2A, 6.3V/2A, 5V/2A	71/1
PF130	200, 230, 240	285	100	6.3VCT/2A, 6.3V/2A, 5V/2A	73/4
PF164	200, 230, 240	325	100	6.3VCT/2A, 6.3V/2A, 5V/2A	75/-
PF160	200, 230, 240	385	100	6.3VCT/2.5A, 6.3V/2A, 5V/2A	83/1
PF152	200, 230, 240	285	125	6.3VCT/3A, 6.3V/2A, 5V/2A	92/9
PF163	200, 230 ,240	325	125	6.3VCT/2.5A, 6.3V/2A, 5V/2A	94/5
PF181	200, 230, 240	385	125	6.3VCT/3A, 6.3V/3A, 5V/2A	104/-
PF174	200, 230, 240	285	150	6.3VCT/2A, 6.3V/2A, 5V/2A	97/6
PF142	200, 230, 240	325	150	6.3VCT/2A, 6.3V/2A, 5V/3A	105/-
PF175	200, 230, 240	385	150	6.3VCT/2A, 6.3V/2A, 5V/3A	121/8
PF173	200, 230, 240	425	175	6.3VCT/3A, 6.3V/2A, 5V/3A	188/4
PF140	200, 230, 240	385	200	6.3VCT/3A, 6.3V/3A, 5V/3A	176/3
PF171	200, 230, 240	385	250	6.3VCT/4A, 6.3V/3A, 5V/3A	231/10

POWER AMP. AND LOW POWER TRANSMITTER UNITS

PF159	220, 240, 260	475	175	6.3V/4A, 6.3V/2A, 5V/3A	205/2
PF172	200, 230, 240	500	200	6.3V/4A, 6.3V/3A, 5V/3A	231/10
PF143	200, 230, 240	600 500	200	2.5V/5A, 2.5V/5A, 5.5V/.5A	256/8
PF147	200, 230 240, 260	1000 750 500	200 250 300	5.5V/.3A	318/4
PF179	200,230, 240	475	225	6.3VCT/4A, 6.3V/2A, 5.5V/3A	199/-
PF107	230, 240	585	250	6.3V/2A, 6.3V/2.5A, 5V/3A	244/5
PF176	200, 230, 240, 260	1250	300	5.5V/3A	488/11
PF177	200, 230, 240, 260	1830, 1100	300	6V/.3A	Price on request

VIBRATOR AND A.C. POWER TRANSFORMERS

PF182	240AC 12VIB	200	40	12.6V/1A	58/6
PF122	240AC 6VIB	220	40	6.3V/2A	58/9
PF125	240AC 6VIB	250	60	6.3V/2A	68/6
PF126	240AC 12VIB	250	60	12.6VCT/1A	68/6
PF119	240AC 6VIB	325	125	6.3V/4A	97/8
PF146	200, 230. 240 AC, 12V, VIB	325	150	12.6VCT/2.5A	115/-

VIBRATOR TRANSFORMERS

CODE NR	PRIM. VOLTS	DC OUTPUT VOLTS	DC OUTPUT mA	BUFFER Full Sec.		RETAIL PRICE
VT100	32	200	40	.005		48/4
VT101	6	90	15	.008		37/11
VT102	6	150	25	.005		44/4
VT103	6	200	50	.005		46/8
VT104	6	250	60	.005		47/9
VT105	12	250	60	.005		49/5
VT106	6	300	75	.008		78/11
VT107	6	250	60	.005	Low Radiation	52/3
VT108	12	90	15	.008		39/5
VT109	24	90	15	.008		41/8
VT110	12	150	25	.005		46/8
VT111	24	150	25	.005		51/1
VT112	12	200	50	.005		48/11
VT113	24	200	50	.005		48/11
VT114	12	300	75	.008		85/-
VT115	24	300	75	.008		85/10
VT116	24	250	60	.005		54/5
VT117	12	250	60	.005	Low Radiation	52/9
VT119	32	150	25	.005		44/2
VT121	6	180	30	.005		48/11
VT122	6	400	50	.005		79/9
VT123	12	320	125	.005		102/8
VT124	32	250	60	.005		53/4
VT127	6	200	50	.005	Low Radiation	48/11
VT128	12	250	60	.005	Low Radiation	57/9
VT146	6 or 12	240AC	50W	.05	For emergency light, etc.	64/2

POWER CHOKES

CODE No.	IND. HY.	DC RES	DC mA	RETAIL PRICE	CODE No.	IND HY	DC RES	DC mA	RETAIL PRICE
CF100	50	1900	10	32/1	CF109	20	225	150	61/3
CF101	30	870	25	31/3	CF110	12	100	200	71/1
CF102	15	300	60	24/5	CF111	16	165	200	71/1
CF103	30	420	60	45/10	CF112	10	70	250	71/1
CF104	30	580	75	48/9	CF113	.5/20	70	250 50	78/4
CF105	15	250	80	41/1					
CF106	12	200	100	41/6	CF114	1.1	23	375 AC	48/9
CF107	30	360	100	56/3					
CF108	12	135	150	58/8	CF115	.017	.6	2A	21/5

GRID INPUT TRANSFORMERS

CODE No.	MATCHING FROM	TO	NOM. IMPEDANCE PRIM.	SEC.	MAX. WATTS	RETAIL PRICE
MT104	Mike, P.U.	Grid	3.7, 50	50,000		48/9
MT105	Mike, P.U.	Grid	3.7, 50	60,000		178/4
MT108	Line	Grid	120	1200		107/6
MT109	Cath.	Grid	100	1000		61/1

LINE TRANSFORMERS

MT100	Line	Spkr.	600	4, 3	15	61/1
MT101	Line	Spkr.	500	15	15	61/1
MT124	Line	Spkr.	600 500	4, 3, 2.7 2.3, 2.	25	102/8
MT125	Line	Spkr.	600 500	15, 12.5 8.4, 6.5	25	100/2
MT111	Line	Spkr.	500	12.5, 8 2.3	10	65/10

MODULATION TRANSFORMERS

MT118	Audio Amp	Class C Amp	8000 6000 P.P.	10,000 7000 5000	25	161/5
MT119	Audio Amp	Class C Amp	8000 6600 3800 P.P.	10,000 7500 6500 5500 4500 3500	50	185/10
MT120	Audio Amp	Class C Amp	500 to 20,000 in steps	500 to 30,000 in steps	50	339/9
MT121	Audio Amp	Class C Amp	500 to 20,000 in steps	500 to 30,000 in steps	125	418/4

DRIVER TRANSFORMERS

MT106	Class A Driver S.E.	Class AB1 Grids	5000 Step Up 1:5 Pri. DC 40 mA	125,000	5	106/6
MT107	Class A Driver HI. MU. S.E.	Class A Grids P.P. or S.E.	10,000 Step Up 1:3	90,000	1	155/5
MT112	Class A Driver HI. MU S.E.	Class A Grids P.P. or S.E.	10,000 Step Up 1:2 5 mA DC unbalance	40,000	.5	97/9
MT113	Class A Driver S.E.	Class AB2 Grids	5000 Step Down 1.25:1 40 mA Pri. Dc.	3200	2	116/3
MT114	Class A Driver P.P	Class B Grids	5000 Step Down 1, 1.5 or 2	5000 2200 1250	5	133/3
MT115	Class A Driver P.P. or S.E.	Class B Grids	5000 Step Down 1.07 or 1.4 40mA DC max unb.	4400 2500	5	133/3

FILAMENT TRANSFORMERS

CODE No.	PRIM. VOLTS	SEC. VOLTS	RETAIL PRICE
PF117	240	2.5V/.3A.	31/8
PF118	220, 240, 260	2.5V/5A, 2.5V/5A.	55/2
PF158	220, 240, 260	5V/8A.	61/1
PF138	220, 240	6.3V/4A, 5V/4A, 2.5V/4A, 2.5V/4A.	86/8
PF162	240	6.3V/3A, 6.3V/3A.	63/9
PF154	200, 230, 240	7V tap 6V/7A, 6.3V/3A, 5VCT/5A, 5V/3A, 2.5V/7A.	183/4
PF102	240	7.5V/2A.	46/5
PF111	240	10V/5A	65/7
PF131	230, 240	10VCT/10A, 5V/15A.	195/7

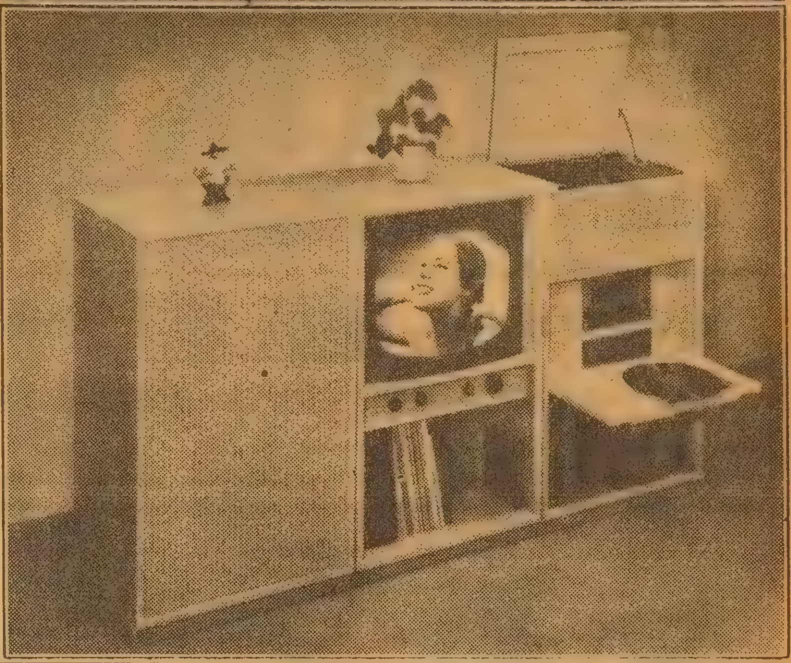
ENGINEERED **TO-DAY** FOR **TO-MORROW'S.** REQUIREMENTS radiation from the back of the speaker.

This design, incorporating a folded tube lined with sound absorptive material, removes radiation in the range down to about 100 cps. At still lower frequencies, the back wave is radiated through the horn. In general, it follows the same acoustic principle employed in the many broadcasting studio monitor systems. Normal bass is smoothed out and the labyrinth extends low frequency response a full octave downward.

THE "CUSTOM FOUR HUNDRED" CABINETS: The three basic matching cabinets available are designed to be used individually, or in any combination of units.

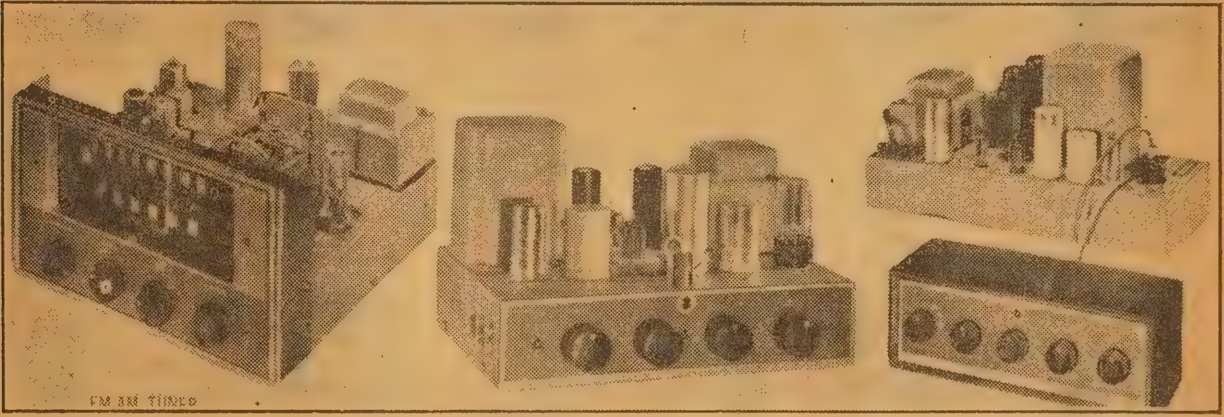
The speaker and acoustical labyrinth are housed in one of the three cabinets. The FM-AM radio tuner, amplifier and record changer unit has ample record storage space; and similar record space is available in the television chassis cabinet. Each cabinet is 20½in deep, 28in wide, and 39½in high.

COMPLETE CUSTOM INSTALLATION



On the right: The combined FM-AM tuner; the standard amplifier complete on one chassis; at the extreme right is the de-luxe amplifier which is used in conjunction with the five-control input unit.

All units asembled in the matching wooden cabinets, provide a radio installation of which anyone could be justly proud.



The Stromberg-Carlson "Custom Four Hundred" line is available for export exclusively through AD Auriema, Inc., 89 Broad St., New York 4, NY. A complete descriptive folder concerning this equipment is available from Ad. Auriema, Inc., upon request.

THE easy examination of phonograph needles for record-damaging wear is now made possible by a magnifying device called the Duoscope, designed by the Duotone Company, manufacturers of all types of replacement needles.

The Duescope is a folding pocket-glass attached to a key chain, with two lenses yielding together 14 power magnification. With the Duoscope, anyone can detect a worn needle and by keeping a check on its wear, change it before it damages a record. Such examination has disclosed that needles made of any material except the diamond, show varying stages of wear after a few playings.

The export distribution of the Duoscope is also handled by Ad. Auriema, Inc.

AS I SEE IT — MODERN TRAVEL

(Continued from Page 13)

of miles more in Asia, Central Africa and South America.

Speeds have not increased notably —the journey from London to Aberdeen could be accomplished, in fact, a little quicker at the turn of the century than today. The emphasis has been on comfort and economy.

The developments in transport by road and air have not destroyed the need for railways, but have rather limited their sphere. For the carriage of heavy goods overland, railways will probably remain supreme.

They will be aided by far more efficient power units and may hold their own in handling of heavy suburban traffic because of their great carrying capacity and speed.

Long distance trains will increasingly lose their passengers to airliners, but by great economy they should be able to secure sufficient traffic to continue operation.

From the beginning, the urge with the aeroplane has been faster and higher—the two are not unconnected. Behind this urge has come that to travel farther. Those trends will continue. The 700 mph which is the maximum today, may well be 7000 mph by AD2000 in aircraft driven by "ramjets" or "rocket motors," in the next stage after the jet engines of today.

Soon 1000 miles per hour or more will be commonplace. The jump may be even bigger on long distance travel, since once the problems of take-off and alighting are solved, the stratosphere will offer almost "free passage" to ramjet planes of greater efficiency.

The second half of the century can contain nothing so revolutionary in transport as that first flight of the Wright brothers, but the first flight into space may come near to it. The great difference will be that the average man and woman will be prepared.

Today the average man is already convinced that a flight to the moon is held up only for lack of money. That is not strictly true. The technical problems, although perhaps solved in principle, remain very great.

1952
LIST OF
RADIO
COMPONENTS

R.C.S. RADIO PTY. LTD.

IF YOUR RADIO RETAILER
CAN'T SUPPLY—RING

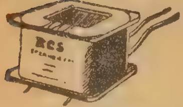
LW3491

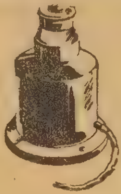
FOR NAME AND ADDRESS
OF NEAREST R.C.S. STOCKIST

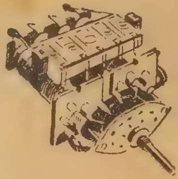
COMPLETE PRICE LIST fully ILLUSTRATED

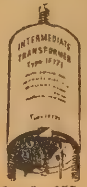
JUST OUT! 1900kc COIL KIT TYPE K124

A complete price list, fully illustrated, of all R.C.S. components is now available. Obtain your copy from your local retailer or write direct to R.C.S. Radio Pty. Ltd.

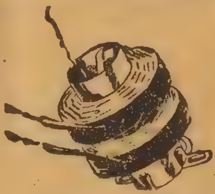

Filter choke.

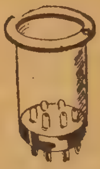

Line filter.


Dual-wave units.



Standard 455—K.C. Intermediate transformer.


Line filter coil.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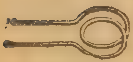
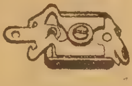

F.M. Coil.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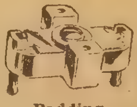
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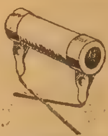
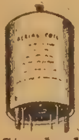
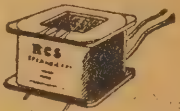
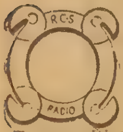

Resistors.

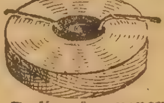

Standard broadcast coil.



Speaker transformer replacement coil.



Transposition block.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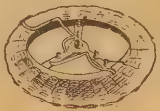
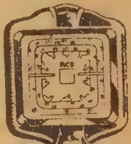
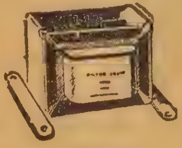

Loop aerial coil.



DA7 dial.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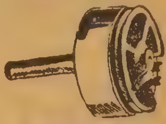
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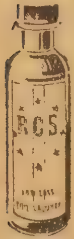
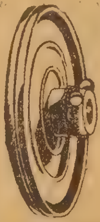
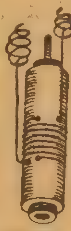
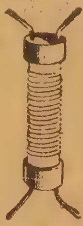
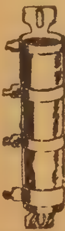


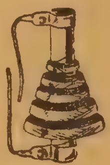
Low loss coil lacquer.

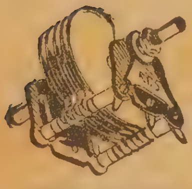

Dial drive drum.

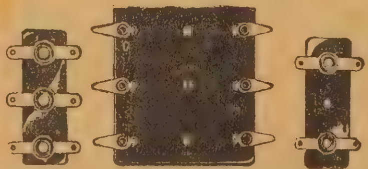

Short-wave Coil.

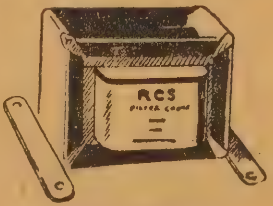

5 band coil.


Voltage divider.

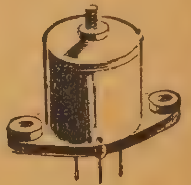

Radio Frequency Choke.


Midget variable condenser.


Resistance strip



Audio transformer.


Midget Magnasonic Coil

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NEWS AND VIEWS OF THE MONTH

Scientific triumph

A HIGHLIGHT of the URSI conference, now being held in Sydney, is the equipment for examination of solar noise, developed by W. N. Christianson, research officer of the Radiophysics Division of CSIRO.

The sun is constantly emitting radiations which can be detected by special radio receivers in the form of "noise," the intensity of which varies with the various types of solar activity, such as sunspots. Because of the important influence the sun has upon our complete system, physicists have always been intensely interested in methods to observe what goes on in that wilderness of flaming gas.

To pinpoint the sources of noise, an aerial system was conceived which would have a beam width so sharp that it could literally scan the surface of the sun.

This aerial system, built almost entirely at CSIRO, is erected at Potts Hill, and consists of 32 parabolic reflectors, all carefully aligned, and feeding the noise-detecting receivers.

It is the only one of its kind in the world and its success is a big tribute to the skill and enterprise not only of Christianson himself, but of the entire group, which has worked in conjunction with the radio astronomy group led by Dr. J. L. Pawsey.

Work of this nature is rapidly building for Australia a big reputation in the field of radio and research.

* * *

More Saucers

YET another batch of reports floods the news concerning flying saucers, which at the time of writing are attracting the intensely practical attention of public, scientists and armed forces. Matching only the mysterious nature of the phenomena is the ingenuity shown by many to explain it.

There is little doubt that many of the saucers seen can be explained by tricks of lights, searchlights, and even electrical and magnetic phenomena. But if all can be so explained, how is it that only in recent years have these reports come so thick and fast?

It has been suggested that strange objects have been reported flying through the sky from time to time almost over the centuries. But these cases appear so isolated that it's hard to think they have necessarily any relationship with each other. It's a fair statement, we imagine, that far more reports from informed observers have been made in six months than in the entire period up to recent times.

Even our most eminent physicists have been recorded as believing that there are genuine saucers as well as furphies, and that at the moment they cannot be satisfactorily explained. Even allowing for the fact that six people can be relied upon to see something strange which is reported by one, very few will be satisfied that the whole thing is a hoax or mass hysteria.

Then there are those radar trackings—not to be explained by temperature inversion or the numerous well-known tricks which radar equipment plays on the operators.

As we remarked on a former occasion, there seems some reason to think that someone is up to something, and we hope that, things being what they are, the saucers are ours and not theirs!

* * *

New luxury train

TRANS-CONTINENTAL trains will soon equal the best in the world in comfort, speed and economical running, Senator McLeay has announced.

Two sets of eight coaches being loaded at Bremen (Germany), would be used on the Port Pirie,Kalgoorlie run.

They will be hauled by fast modern diesel-electric locomotives already in service.

"The coaches are fitted with special bogies, which will make high speed travel over the 1100-mile journey as comfortable as a plane journey on a calm day," Senator McLeay said.

"They will be air-conditioned,

POPULAR SCIENCE QUIZ

Q.: Can any animal live for years without food?

A.: A distinguished Cambridge scientist, Sir Arthur Shipley, once described a very small creature known as the tardigrada, a distant relative of the spiders and popularly known as the water-bear, which can dry up until apparently all life is extinct. After remaining in that condition for years it can, with the aid of moisture, revive and live its normal life once more.

These creatures live naturally in a damp atmosphere but, if the atmosphere tends to dry up, they also dry up. All movement gradually ceases, the body shrinks until it looks like a battered grain of sand. It will remain this way year after year, to all appearances dead.

However, if placed in water, it will, in a few minutes, swell out, the wrinkles will disappear, the legs will stretch out and gradually it will move. In an hour or so the creature is as active as ever and crawls away.

Some of the snails, too, can remain apparently dead for years without food and then revive and live as though nothing has happened to them.

A striking example of this was a desert snail from Egypt, which supposed to be dead, was fixed to a tablet in the British Museum in 1846. Just on four years later, it was observed to have come out of its shell. It was removed from the case and lived for a considerable time.

Q.: Can a plant grow under ice?

A.: There is an interesting little alpine plant called the soldanella which is capable of doing just this. During the summer months the flat leaves are exposed to the sun and the plant stores up fuel until the leaves are quite fat. As time passes, they flatten to the ground and when the snow falls, the hard, leathery covering of the leaves protects them from damage.

The plant lies dormant during winter but, in early spring, water gets to the root and causes the plant to germinate. A bud begins to open and, using the fuel stored in the leaves, melts a place for itself in the snow or ice.

It continues to melt the snow until it reaches the fresh air, even though the snow freezes again around the stem. The bud develops into a flower and by the time the ground is clear of snow, the soldanella is practically a full-grown plant. It goes through the usual process with the bees to produce seeds for the carrying on of the species and then goes through the same cycle the following year.

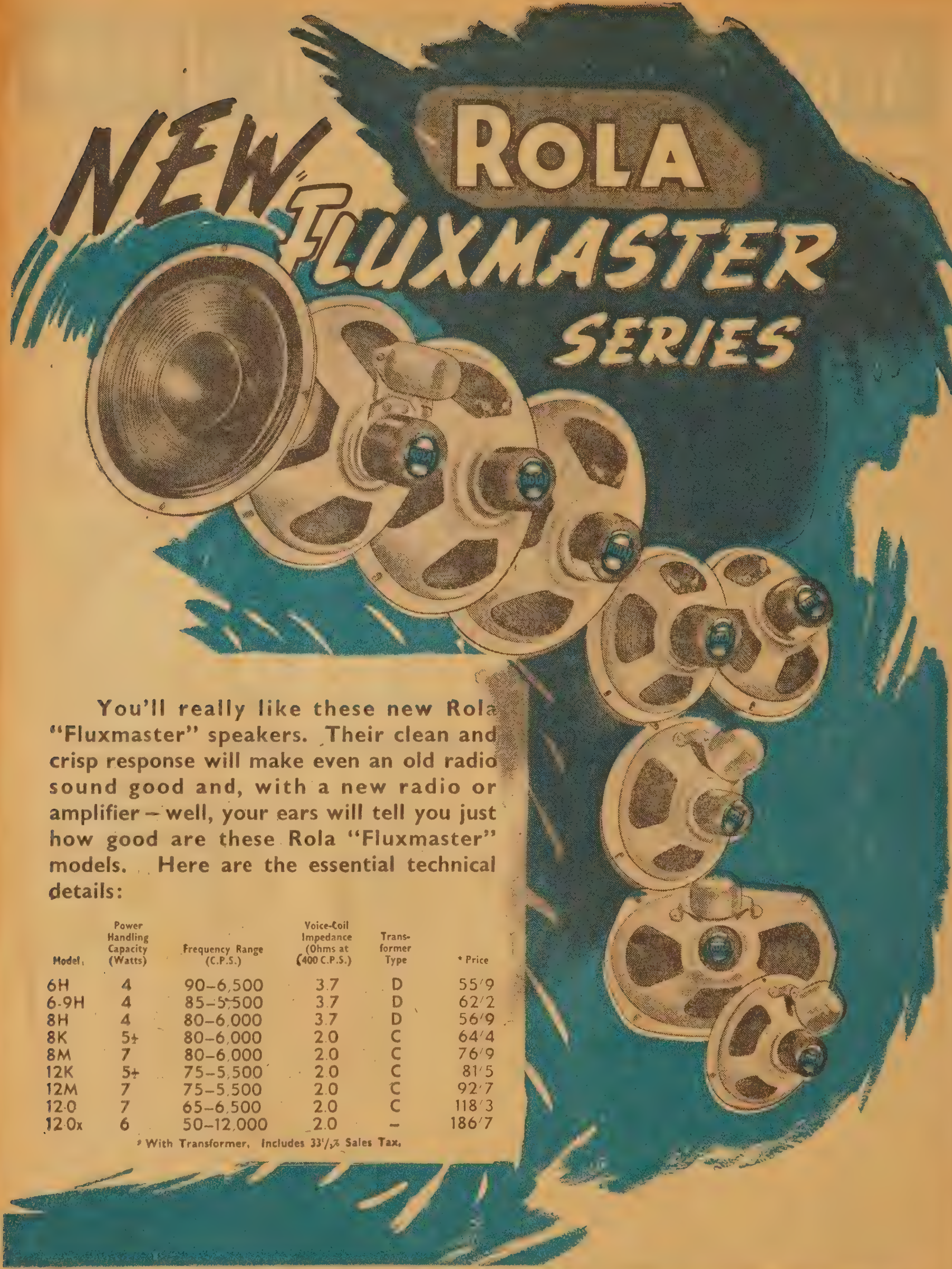
Q.: Is Kew, England, known for anything other than the "Kew Gardens" pleasure resort?

A.: It is the botanical research centre of the Empire. In the Herbarium there is to be found a huge collection of plant specimens from all over the world. The work of identification and classification of these specimens has great commercial value. For instance, of the two varieties of the camphor plant, camphor oil can be obtained from one but from the other, solid camphor can be extracted. Solid camphor has much greater commercial value. It has been said that the two varieties can be identified by an expert botanist only.

Another example of the work of the botany experts at Kew research centre was in the case of the rather beautiful yellow wildflower known at St. John's Wort. This plant was accidentally introduced into Australia where it spread rapidly and proved exceedingly destructive to some of the most important native plants.

It was taken for granted that it was the ordinary British St. John's Wort, and a certain type of insect, known to be destructive to the plant, was introduced into the country. The result was negative and the plant continued to flourish.

When the matter was taken up with the botanists at Kew, England, it was discovered that the plant was not the English variety, but the Continental variety. It was very similar but had to be attacked with a different type of insect.



NEW ROLA FLUXMASTER SERIES

You'll really like these new Rola "Fluxmaster" speakers. Their clean and crisp response will make even an old radio sound good and, with a new radio or amplifier — well, your ears will tell you just how good are these Rola "Fluxmaster" models. Here are the essential technical details:

Model.	Power Handling Capacity (Watts)	Frequency Range (C.P.S.)	Voice-Coil Impedance (Ohms at 400 C.P.S.)	Transformer Type	* Price
6H	4	90–6,500	3.7	D	55/9
6-9H	4	85–5,500	3.7	D	62/2
8H	4	80–6,000	3.7	D	56/9
8K	5½	80–6,000	2.0	C	64/4
8M	7	80–6,000	2.0	C	76/9
12K	5½	75–5,500	2.0	C	81/5
12M	7	75–5,500	2.0	C	92/7
12·0	7	65–6,500	2.0	C	118/3
12·0x	6	50–12,000	2.0	–	186/7

* With Transformer. Includes 33⅓% Sales Tax.

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sound-proof and dust-proof, and fitted with every conceivable modern convenience."

Senator McLeay denied that they were Royal Tour trains.

"They were ordered long before the Royal Tour was ever thought of," he said.

Using the diesel-electric locomotives the existing 44-hour timetable would be reduced to 22 hours.

First of the new trains, which were chosen by Commonwealth Railways Commissioner P. J. Hannaberry, after a tour of the United States, Canada, the United Kingdom and Europe, is expected in October.

* * *

International TV

BRITAIN and France have begun the first direct international exchange of television transmissions.

While it is possible for French and English receivers to be within range of both nations' television stations the different standards in use in the two countries precludes one nation "looking in" on the other's programs.

This problem of different television standards has been overcome by the setting-up in France of Marconi image orthicon cameras built to the British standards.

These cameras, housed in a studio at Mont Cassel, scan special large-screen receivers displaying the French program.

A Marconi micro-wave relay system operating from Mont Cassel-Alembon-Dover and thence to London carries the camera's image to the BBC's transmitters.

The French program is thus relayed to Britsh audiences just as any program enacted in the London studios of the BBC would be telecast.

* * *

3-Dimension films

THREE-DIMENSIONAL color films, with three-dimensional sound, have been screened privately in USA.

Experts said the development might ensure the survival of Hollywood in the age of television.

Cinerama Productions, headed by Mr. Lowell Thomas, radio news broadcaster, and Mr. Merian Cooper, a film producer, made the film.

Members of the preview audience said they had the sensation of flying over real mountains and cities in a travelogue filmed from the air.

Watching a scene from Aida, filmed at the La Scala Opera House in Milan, they said they felt like members of the cast.

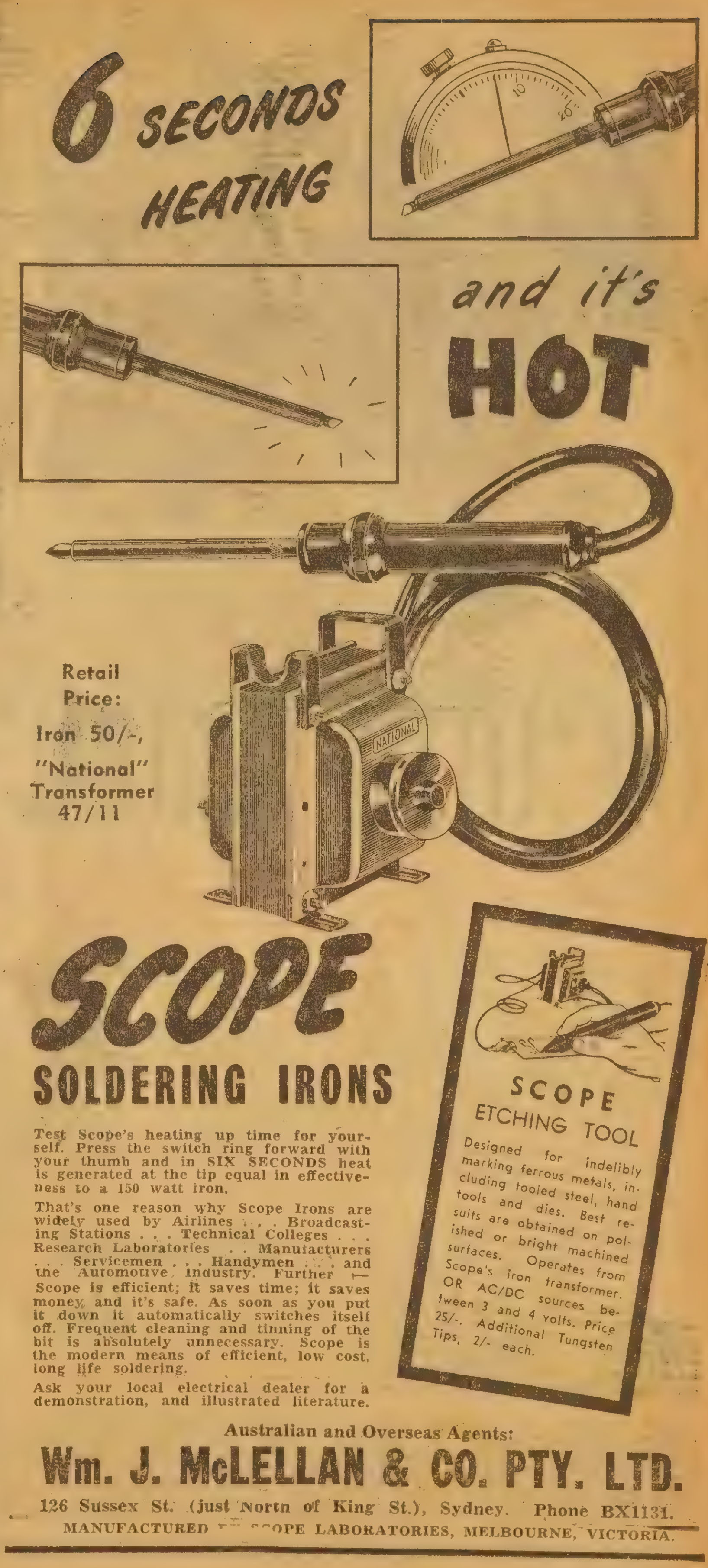
The three-dimensional sound system, perfected by Mr. Hazard Reeves, of Hollywood, made use of six microphones during the shooting of a film, and eight loudspeakers were spotted about the cinema to direct sound effects and dialogue realistically to the ears of the audience.

* * *

Trees spot minerals

AN interesting method of locating minerals is used in Canada by "biogeological" prospectors. They examine the foliage of suitable trees in the area to be prospected, working on the knowledge that these will in many cases contain traces of the minerals present in the soil through which the roots pass.

The method is to collect specimens from the trees which experience has indicated are most likely to contain mineral traces, and to reduce them to ash by heating.



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and it's HOT

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Iron 50/-,
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Test Scope's heating up time for yourself. Press the switch ring forward with your thumb and in SIX SECONDS heat is generated at the tip equal in effectiveness to a 150 watt iron.

That's one reason why Scope Irons are widely used by Airlines . . . Broadcasting Stations . . . Technical Colleges . . . Research Laboratories . . Manufacturers . . . Servicemen . . . Handymen . . . and the Automotive Industry. Further ← Scope is efficient; it saves time; it saves money, and it's safe. As soon as you put it down it automatically switches itself off. Frequent cleaning and tinning of the bit is absolutely unnecessary. Scope is the modern means of efficient, low cost, long life soldering.

Ask your local electrical dealer for a demonstration, and illustrated literature.

SCOPE ETCHING TOOL

Designed for indelibly marking ferrous metals, including tooled steel, hand tools and dies. Best results are obtained on polished or bright machined surfaces. Operates from Scope's iron transformer, OR AC/DC sources between 3 and 4 volts. Price 25/-. Additional Tungsten Tips, 2/- each.

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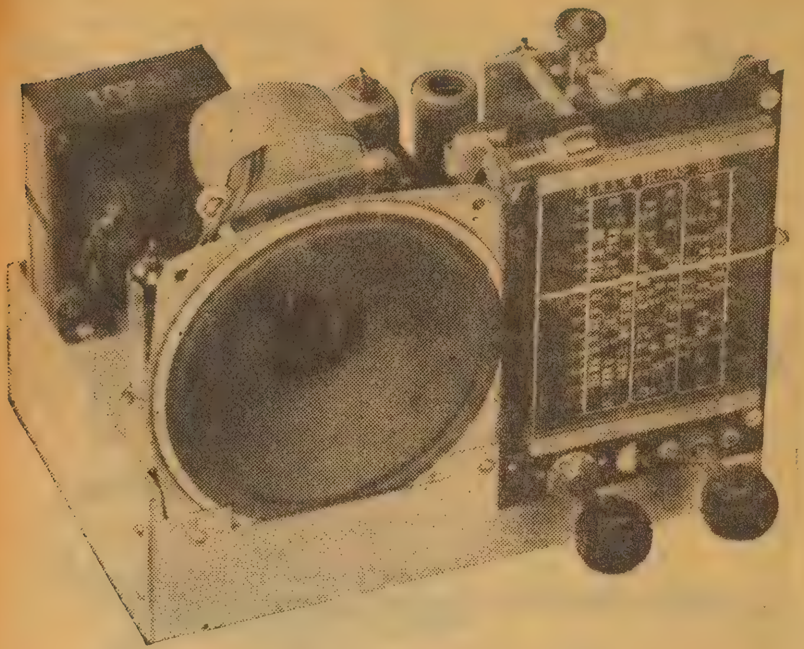


This view of the set illustrates the general compactness. The knob on the left is the "volume," with the "tuning" on the right. The ready-made chassis will take most well-known 5 inch speakers.

THE 'LITTLE GENERAL' FOR 1952

Here is another of the famous "Little General" mantel sets featuring the very latest types of valves and a new easy-to-wire layout with miniature components. Designed especially for the home constructor, it sets a new high in "Little General" performance.

by Raymond Howe

WITHOUT a doubt the Little General style of set has been the most successful of the mantel sets presented to the home builder. Because of its simplicity of construction and good performance many thousands of these sets have been constructed over the years.

Naturally enough, new components appear on the market from time to time, and at regular intervals we bring the famous Little General up to date by taking advantage of them.

STANDARD CABINET

On each occasion we try to avoid any radical change in the basic design so that the chassis, and especially the cabinet, can always be obtained. With the widespread swing to miniature valves a couple of years ago the layout of the chassis for the Little General for 1951 was arranged to take either the miniature or the octal-based types. Also, a more pretentious dial was fitted, in line with numerous requests to do so.

However, the continued use of the standard sized coils and IF transformers necessitated mounting the aerial and oscillator coils on a bracket underneath the chassis. This practice, while quite effective from all other angles, did reduce the amount of free wiring space—a point to be considered for the less-experienced home builder.

With our latest version, the 1952 Little General, the main theme was to be absolute simplicity of wiring. To this end we determined to use miniature coils and IF transformers and to have the major components on the top of the chassis. This would leave the underside as clear as possible and give the budding home constructor as much freedom for wiring as possible.

It was obvious that a new chassis design would be called for. Accordingly, a new layout was arrived at which, however, maintained the position of the dial and speaker and the overall size of the chassis. Thus the standard Little General cabinet can still be used to house the finished job.

The underchassis view shows the measure of success that has been achieved. There is much more room to lay the components, the majority of which have been laid on a mounting strip.

The set performs very well. It plays all the local stations with volume to spare for normal listening conditions and, furthermore, we tuned in many country stations even from this electrically noisy position in the heart of the city.

In the circuit design the major change is in the valve types. Of course there is no reason why the valve complement used in the 1951 Little General could not be used equally well in the amended layout. However, we selected more recent valve type releases, the combination exhibiting a little more overall gain.

The converter stage carries the 6AE8, which is electrically very similar to the 6AN7. Although this valve has a zero bias rating with 75 volts on the screen we preferred to run it with a good two volts of bias and a screen voltage approximately 90. This is in line with the local manufacturer's preference, the zero bias condition tending to emphasise difficulties with grid current and input impedance. It was more convenient, too, because we wanted the AVC line to carry a standing negative bias of this order for the IF stage.

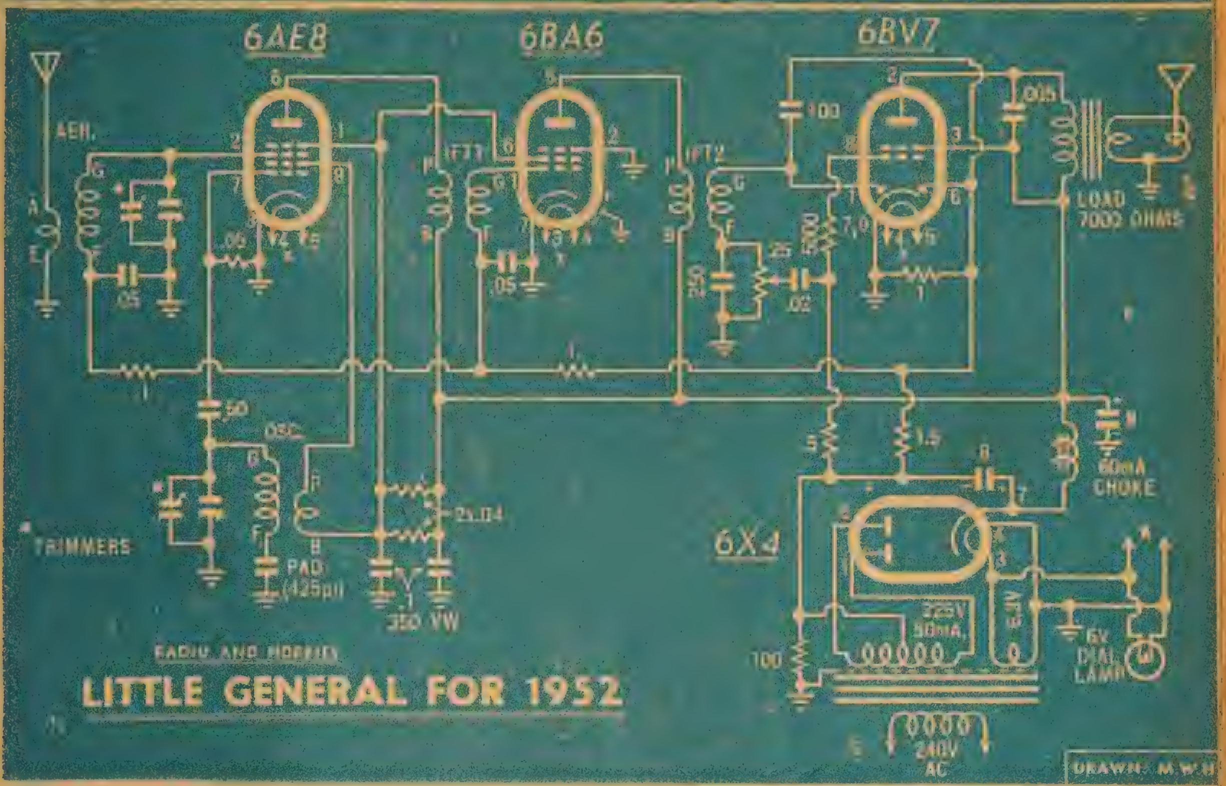
The high Gm 6BA6 is used in the IF stage. This choice was influenced by the availability of the 6BV7, a duo-diode output pentode, meaning that the IF valve could be a high-gain RF pentode instead of a duo-diode medium-gain pentode used in the previous versions.

The screen is fed from the common feed point for the 6AE8 screen and oscillator anode. AVC is applied and, as already mentioned, about two volts of bias is applied through the AVC line.

Although the feeding of the screens of the converter and IF stages from a common point did not introduce any instability, a common point for the AVC feed to these stages tended to be a little "touchy." To avoid any possible trouble, therefore, we inserted separate decoupling components for the AVC feed to each of these stages.

The output stage uses the recently released 6BV7, a duo-diode power output pentode. This valve was designed primarily for use in receivers such as this. According to the manufacturer the location of the diode anodes in the audio valve envelope allows higher IF gain to be obtained

CIRCUIT USES HIGH GAIN VALVES THROUGHOUT



The circuit design is simple and yet capable of good performance. The .005 mfd at the plate of the 6BV7 may be returned to the screen as shown or to the chassis. If other valve types are substituted, make sure that they receive their optimum screen and grid bias voltages.

without running into the troubles of regeneration. Reason for this has to do with, the reduction of overall input-to-output capacitance figures within the valve and its socket.

One of the 6BV7 diodes is used for detection and the other for developing AVC voltage. No RF filter was used at the "hot" end of the detector diode load, the single 250 pf. capacitor providing sufficient bypassing.

The AVC diode is fed, in turn, from the detector diode and is provided with two volts from the back-bias network. You will note that it is connected to the junction of the 1.5 megohm and the 1 megohm resistors across the 100 back-bias resistor between the transformer centre-tap and chassis.

BIAS VOLTAGES

Actually, 5 volts is developed across the 100 resistor, but the two high value resistors form a voltage divider to provide the two volts. The two parallel resistors in this divider also act as the AVC diode load. The two volts on the AVC line acts as bias for the converter and IF valves and also as a delay voltage for the AVC diode.

Incidentally, this "delay" voltage merely means that the AVC diode will not develop a control voltage for the converter and IF valves until the RF signal level at the AVC diode anode is greater than two volts. This allows maximum sensitivity to be available for tuning weak stations.

The grid of the 6BV7 pentode portion is biased by returning the .5 megohm grid resistor to the 100 ohm back-bias resistor. Note that there is a 5000 ohm resistor between the grid coupling capacitor and the actual grid pin of the valve. This is a "grid stopper" and is normally used with any high Gm power output valve to prevent parasitic oscillation.

The .005 mfd capacitor between the plate and screen of the pentode is a further precaution against instability. It also introduces a fixed amount of treble attenuation, in line with common practice for mantel sets.

The power supply uses the minia ture 6X4 rectifier in conjunctio with the 225 volts per side, 50 m transformer. High tension filterin is provided by a standard 60 m filter choke and a pair of 8 mf electrolytic capacitors.

By the way, there is no incongruit between the 50 mA transformer an a 60 mA filter choke. A 50 m choke is not a standard rating.

At the output of the filter net work, the available high tensio voltage is around the 230 volt mar

The 6BV7 pentode portion ca deliver a power output of four wat

PARTS LIST

1 chassis 8½in x 5½in x 2¼in. (1952 Little General)

1 power transformer 225V a side 50 mA, 6.3V at 2A. (PF 201 or similar).

1 filter choke, 60mA.

1 2-section miniature tuning gang.

1 dial with glass to match gang (SLV21)

2 gang-section trimmer capacitors.

1 miniature aerial and 1 miniature oscillator coil (suit 6AE8).

2 miniature 455 Kc IF transformers, Nos. 1 and 2.

1 5 inch speaker with 7000 ohm transformer.

2 miniature 9-pin valve sockets, 2 miniature 7-pin valve sockets, (one with shield).

VALVES

1 6AE8, 1 6BA6, 1 6BV7, 1 6X4.

CAPACITORS

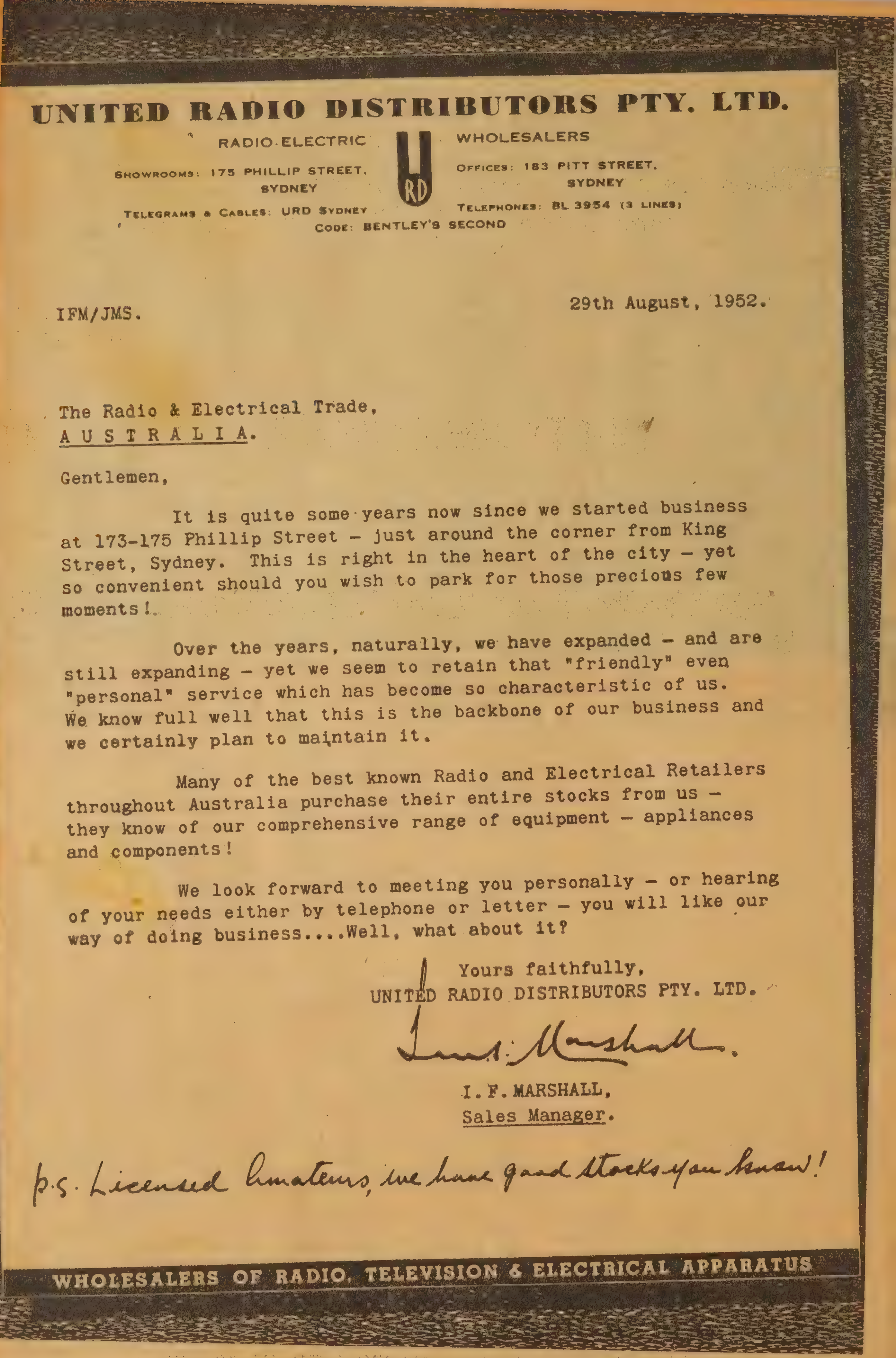
2 8 mfd 450 or 525PV electrolytics, 2 .1 mfd 350WV, 2 .05 mfd 200 or 350WV, 1 .02 mfd tubular, 1 .005 mfd tubular, 1 425 pf mica (low tolerance), 1 250 pf, 1 100 pf and 1 50 pf miniature.

RESISTORS

1 1.5 meg. ½w., 2 1 meg. ½w., 1 .5 meg. ½w., 1 .25 meg. potentiometer, 1 .1 meg. ½w., 1 .05 meg. ½w., 2 .04 meg. 1w., 1 5000 ohm ½w., 1 100 ohm 1w.

SUNDRIES

2 knobs, 3½in resistor mounting strip, 1 3-tag mounting strip, 1 6V dial lamp, 4 rubber grommets ⅜in i.d., spaghetti covering, 3-core power flex with 3-pin plug, hook-up wire, solder lugs, solder, nuts, bolts, &c.



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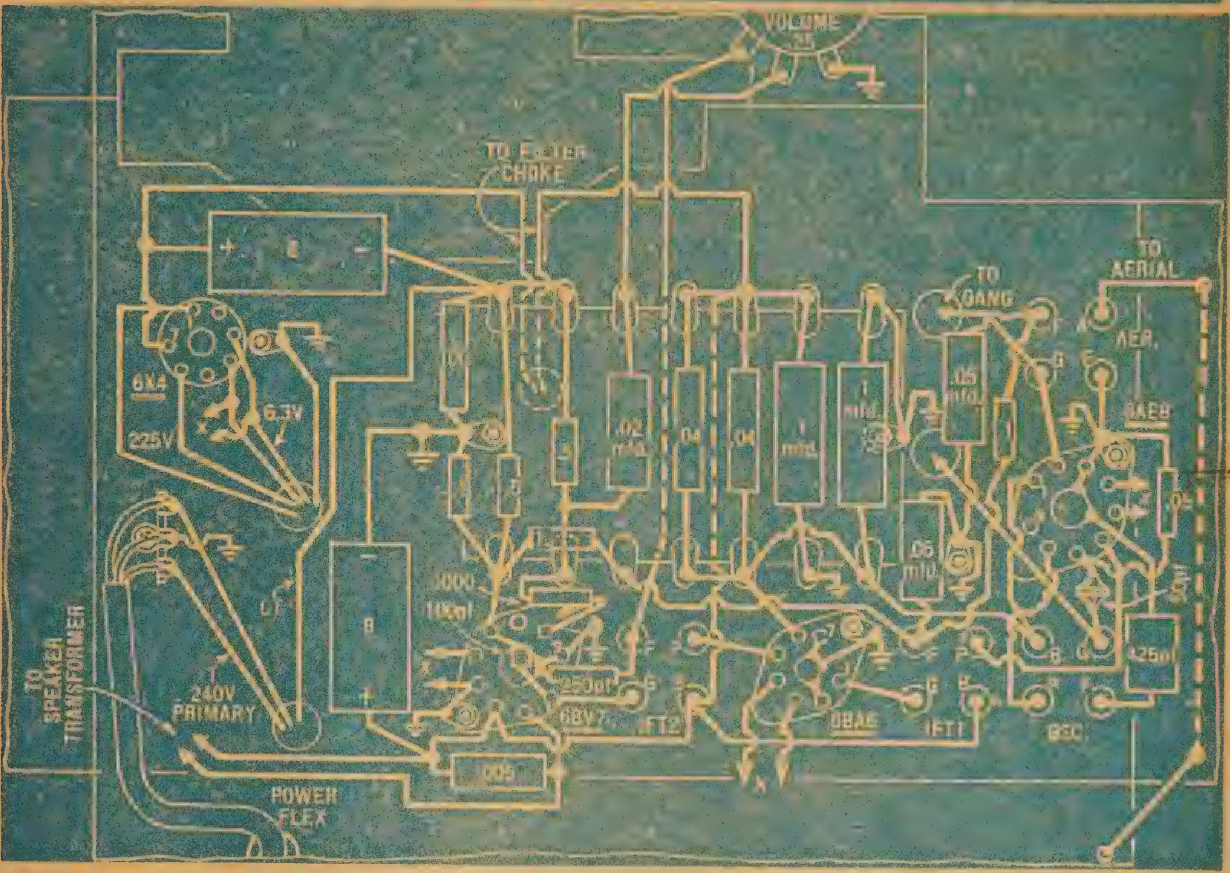
DETAILED WIRING DIAGRAM OF "LITTLE GENERAL"



With the aid of this wiring diagram you cannot fail to get every wire in its right place. The solder lugs are shown held under nuts for connection to the chassis. Note the polarity of the 8 mfd electrolytic capacitors. The dotted lines indicate leads passing underneath the mounting strip.

for 250 volt plate and screen operation, and so, with 230 volts applied, you can expect a healthy output from the speaker when tuned to strong local stations.

So much, then, for the circuit design.

On the practical side, we feel that any home constructor with the aid of the coded top view of the set and the wiring diagram should have no difficulty with the wiring of the set. He should have it functioning at the first attempt.

TOP PICTURE

The coded top view indicates the particular position of each of the major components. The mounting brackets supplied with the tuning gang can be secured at either end of the gang frame. You will see from the photograph which end on which to mount them, so that the gang moving plates open up as indicated.

Before fitting the tuning dial, snip out a length of the wire passing through the dial glass retaining clamps and bend up the end of each remaining piece. This avoids having to let this wire into the chassis for flush fitting of the dial back plate.

The dial drum drive is removed from the dial back plate and "floated" on the tuning gang spindle. The dial is held in place on the chassis by one bolt and the volume control potentiometer. If desired, additional bracing can be provided by a small bracket between one corner hole of the speaker frame and the bolt holding the dial lamp bracket.

It is a good plan to cut the knob shafts to appropriate length to fit the cabinet before commencing the wiring. It is easier that way and also easier on the controls.

When tightening the bolts securing the speaker, avoid any tendency to warp the speaker frame, as it can cause the voice coil to foul the pole pieces. If necessary, use spacing or packing washers on the front edge bolts.

The method of mounting of the coils and IF transformer will depend upon the brand of manufacture. In any case, see that the cans make good contact with the chassis, scraping some of the chassis paint away from the appropriate spots, if necessary. With some types, a solder lug can be locked under the assembly, nut at the top of the can, and connected to the underneath earth system by a thin piece of tinned copper wire.

The underchassis wiring diagram will indicate the particular orientation of the valve sockets, coils and IF transformers and also the bolts under which it will be handy to have solder lugs for earth connections to the chassis.

It is wise to connect all of these solder lugs together with a run of light-gauge tinned copper wire in case one of them should develop a bad contact with the chassis. Of course, with a large enough iron, it would be possible to solder direct to the chassis, but it is liable to char the paint on top if too much heat is applied.

6BA6 SOCKET

We have used a 7-pin miniature wafer socket for the 6BA6 valve rather than the 7-pin moulded type. The capacitance between pins in the former type is less than that in the latter, and this factor tends to assume some importance in a high-gain stage. We strongly recommend that you do the same.

The 6BA6 valve is shielded as a precaution against instability. There are shields available to go with this minature wafer socket.

We secured a 3-tag mounting strip under one of the bolts holding the power transformer to provide the junction point for the transformer primary leads and the incoming flex from the power mains. Fit rubber grommets in the holes in the chassis through which the leads from the power transformer and the incoming power flex pass.

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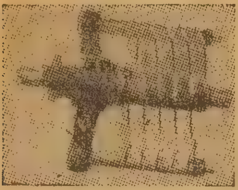
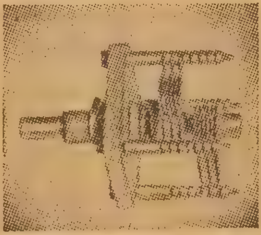


Cat. No.		
476	15 x 15 PF split stator	1 12 0
580	12.5 PF single section double spaced	1 5 8
581	60 PF single section screw-driver adjustment	1 8 6
582	60 PF single section	1 10 10
584	34 x 34 PF Butterfly type	1 13 6
586	140 PF single section	1 13 6
588	27.5 PF double spaced	1 11 4
719	25 x 25 PF differential	1 13 0
739	8 x 8 PF butterfly double spaced ..	1 10 10
699	2—12 PF Neutralising heavy duty ..	6 4 0
756	1.5 to 8 PF Neutralising condenser ..	1 13 0
1130	100 PF single spaced microdenser	1 10 0
418	1.5 to 4.5 PF Neutralising condenser	1 13 0



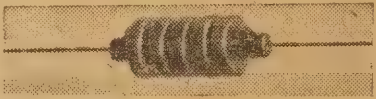
FORMERS & HOLDERS

538	Six pin threaded former	11 0
964	6 pin coil base chassis mounting	6 8
646	Small ribbed former	6 0
647	Small plain former	4 8
648	Small threaded former	4 8
763	Four pin former plain	7 2
765	Four pin former threaded	8 4

INSULATORS

564	Red Cone insulator Maximum overall 1½" reversible fixing base 2000 volt working.	6 6
565	Black Cone insulator Maximum overall 1½" reversible fixing base 2000 volt working.	6 6
1090	Frequentile transmitting coil .. .. former length 5in, diameter 2 11/16in	1 13 0
1091	Sub-base for 1090	1 9 8
1092	Base for 1090 ..	1 9 8
946	Glass aerial leadins	13 8
916	Stand off insulator (Vitreous Porcelain) overall height 1 3/8in . ..	5 6
1018	Lead-through insulator (frequentile) double cone type ..	8 6

R. F. CHOKES



1066	All wave choke 13 MH, 24 Mc/s—150 Kc/s	13 2
1011	U.H.F. choke 5.6 Uh 120—25 Mc/s . ..	6 8
1022	G.P.S.W. choke 1.25 mH 250 m/a 60—1.5 mc/s	10 0
776	2.5 m/h choke 250 m/a transmitting type	10 0
1010	G.P.S.W. choke 1.25 m/h 50 m/a 60—1.5 mc/s	7 8

EDDYSTONE ACCESSORIES

696	Absorption Wavemeter 1.5 — 160 Mc/s	21 13 6
669	"S" Meter Unit ..	18 11 0
687/1	Vibrator Power Unit (6 volt) . ..	33 12 4
709	Tuner unit 145 Mc/s	3 8 4
728	IF output transformer 10 Mc/s ..	1 12 10

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706/LB	33—15 Mc/s ..	18 8
706/Y	16—6.7 Mc/s ..	18 8
706/R	7.5—3.1 Mc/s ..	18 8
706/W	3.3—1.35 Mc/s ..	1 3 0
706/P	1.4 Mc/s — 720 Kc/s	1 3 0
706/G	705 — 300 Kc/s	1 3 0
706/BR	370 — 150 Kc/s	1 3 0
707	Coil base (for 706)	7 2

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659	Similar to model 670 but suitable for AC only	98 7 2

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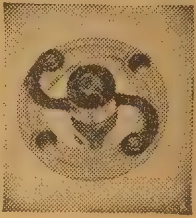
593	Instrument knob ¾ O.D.	4 6
1027	Large pointer knobs	4 6
1044	Small pointer knobs	2 2
2146P	Skirt knob 1¾in diameter	6 8

COUPLERS AND MOUNTINGS



529	Flex insulated coupler medium ..	10 0
550	Flex insulated coupler small . ..	10 0
530	Flex driving shaft	1 1 0
1008	Extension control outfits ..	8 10
1007	Adjustable insulated brackets	8 10

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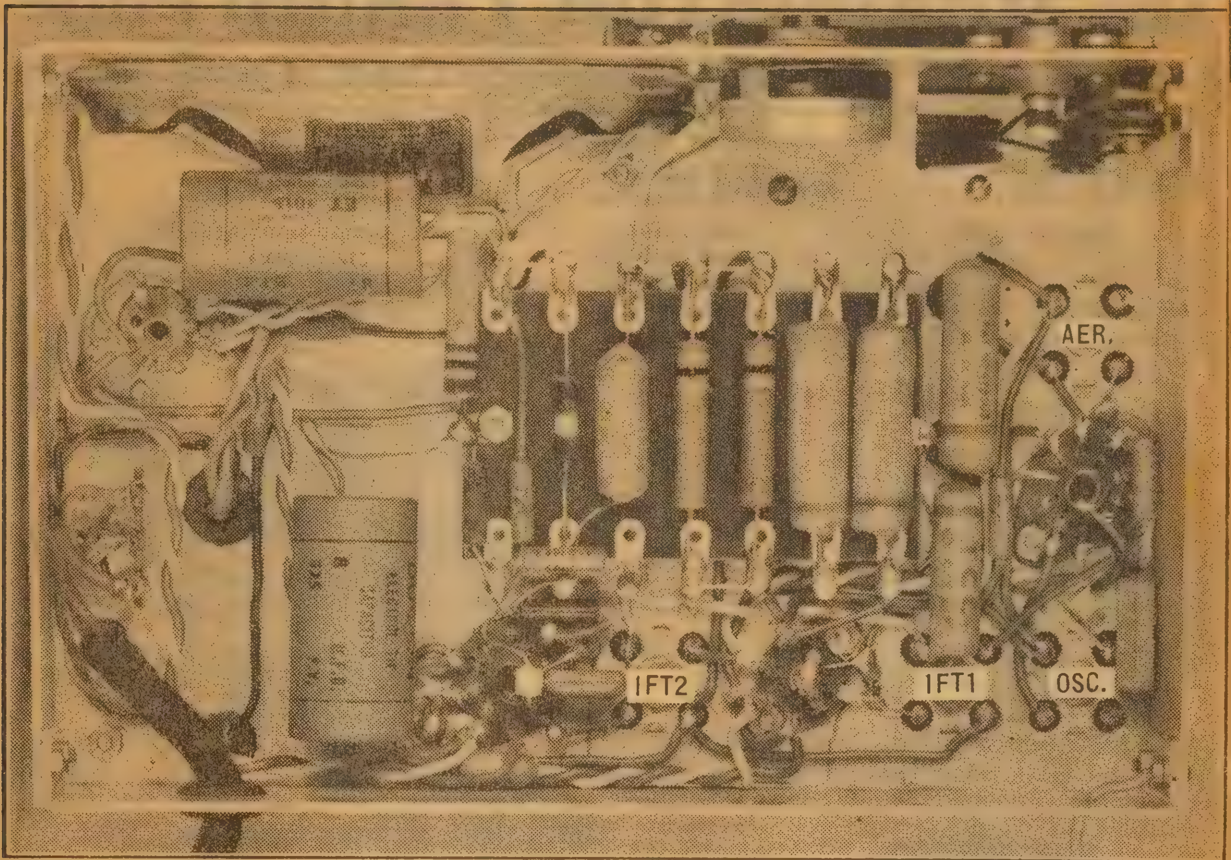

This view is included to give you an idea of what the finished job looks like. Lay the wires in neatly and keep them tucked close to the chassis where possible. Do not forget to earth the centre spigot of each valve socket.

Use a 3-core flex for the power connection, with the red and black cores connecting to the primary winding and the green core connecting to the chassis. The green core should then be connected to the earth pin of the 3-pin power plug.

The first step in the actual wiring would normally be to lay in the simple wiring runs between valve sockets, coils, gang, IF transformers. Go from one valve socket to another, earthing the appropriate pins and the centre spigot.

It is important that this centre spigot of each socket be earthed as it acts as a shield between the pins of the valve. It does not matter in the case of the rectifier valve, of course. Be sparing with the solder flux to avoid getting it between the valve socket pins.

EARTHING HEATERS

Note that one side of the 6.3-volt heater wiring is connected to the chassis. This can be done at any of the sockets of the first three valves, or at each of them. In the latter case, make sure that the same side is being earthed at each socket, or you will short out the transformer winding.

When wiring to the coils and IF transformers, do not apply too much heat to the connections as you may affect the connections within the can. Another point to watch is that, if too much solder is used for these connections, it may short-circuit to the chassis.

On the tuning gang, the section nearer the dial is used for tuning the aerial coil and the rear section for tuning the oscillator coil. We did not fit an aerial terminal on the chassis as several inches of free lead hanging from the set can serve just as well for connection to the aerial. The lead is taken from the appropriate connection on the aerial coil base, through and along the side face of the chassis and out the rear face.

RESISTOR STRIP

Most of the minor components are mounted on 3½ inches of resistor mounting strip. This is held clear of the chassis by two bolts about ¾in long. The wiring diagram shows the suggested order of the components and the connections to the strip.

The ½-watt size of resistors is used where possible. Do not use the ½-watt where the 1-watt size is specified. We used the smaller physical size of capacitors wherever possible. For the 100 pf between the two diode anodes and the 50 pf oscillator grid capacitor, the miniature imported types were used. Do not apply too much heat to the leads of these small capacitors, otherwise the lead is liable to come adrift.

The leads from the plate and screen of the 6BV7 to the output or speaker transformer mounted on the speaker should be twisted together and taken around the power supply end of the chassis to pass up through the speaker cut-out to the transformer.

The alignment procedure is not difficult. The first step is to see that the dial drum is secured to the gang spindle in a position which allows the dial pointer to have equal overlap at each end of its travel as the gang moving plates move from one extreme to the other.

If you have no service oscillator available, you can assume for the time being that the IF transformers are not very far from the mark, provided, of course, that the slugs have not been moved since leaving the factory.

Connect an aerial to the set and tune to a station toward the high frequency end of the dial. Anywhere from about 1200 Kc to the 1600 Kc mark will be all right. Identify a station within that tuning range and adjust for maximum volume the trimmer connected across the aerial section of the tuning gang. Now adjust the trimmer across the oscillator section of the gang until the selected station is being tuned in at its correct spot on the dial.

OSCILLATOR TRIMMER

This is achieved by turning the oscillator trimmer screw a fraction of a turn in or out and noting the new position of tuning of the station. If the move happens to be away from its correct spot, turn the trimmer screw in the other direction.

The correct direction in which to turn the oscillator trimmer screw can be deduced in this manner. If

The WARBURTON FRANKI Page

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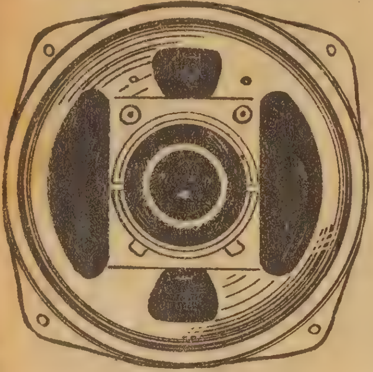
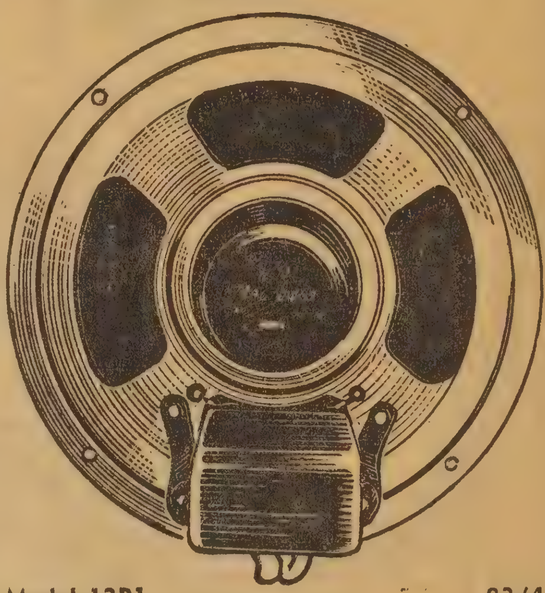


6P2—6"	56/1
6P1—6"	60/7
8P2—8"	59/1
8P1—8"	64/9
10P2 - 10"	69/3
10P1 - 10"	74/11
12P2 - 12"	74/4



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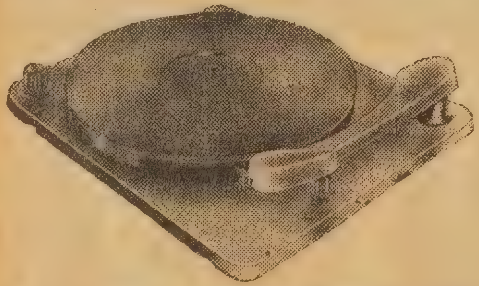
Model 12P1	**83/4**



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the spot at which the station is tuned is on the high frequency side of its marking on the dial, the oscillator trimmer screw will need to be unscrewed, and vice versa.

Once the oscillator trimmer has been set, adjust the aerial trimmer for maximum volume.

Now tune in a station at the low frequency end of the tuning range. In Sydney, station 2FC is a handy marker for this end of the dial. Adjust the slug in the oscillator coil until the selected station is being tuned in at its correct spot on the dial. Adjust the slug in the aerial coil for maximum volume from its station.

I.F. SLUGS

The next step is to tune in any station, preferably a weak one, and adjust the slugs protruding from each end of the IF transformers for maximum volume. Begin with IFT2 and then move to IFT1. Repeat the adjustments at least once.

It will more than likely be necessary to tune to the selected station at the high frequency of the tuning range and go through the adjustments of the oscillator and aerial trimmers once again as alteration in the original setting of the oscillator and aerial coil slugs may have caused some variation at this end of the tuning range.

Actually, it would be wise to go through the complete alignment procedure again just to make sure that all adjustments are right on the "peak." Always try to work with a weak signal by selecting a weak country station or by tuning in a local station with a very short aerial.

For a large change in the length of aerial after the alignment is completed, "re-peak" the aerial trimmer and, if you want to be critical, check the adjustment of the aerial coil slug.

There is really no difficulty involved in the alignment of a superhet. set. It takes longer to outline the procedure in words than to do the job itself. The golden rule is to adjust coil slugs only at the low frequency end and the gang section trimmers only at the high frequency end.

USING OSCILLATOR

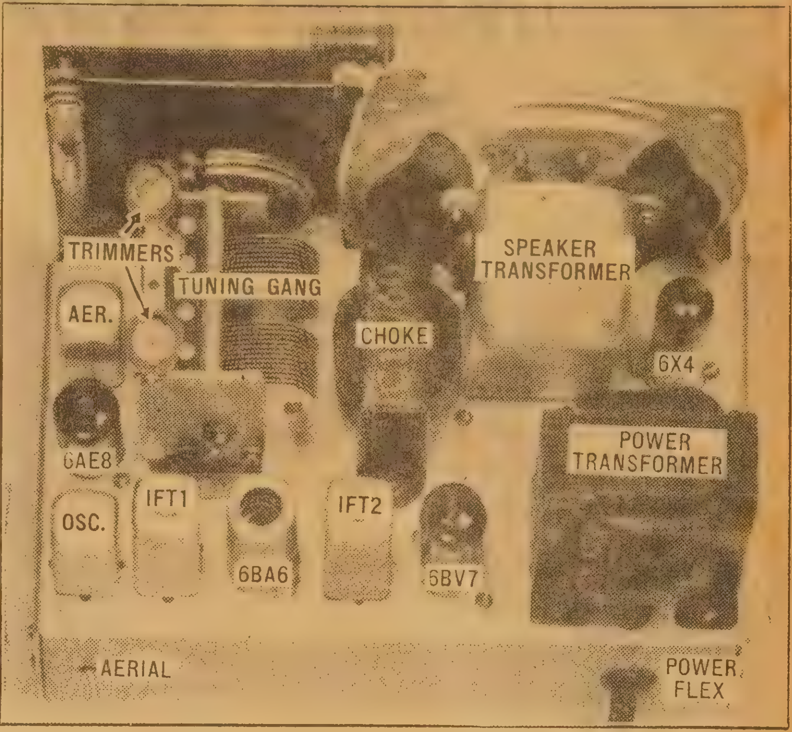
If you have a service oscillator, couple it to the top of the aerial section of the gang—that is, the grid of the converter—and set the IF transformer slugs first for maximum output at 455 Kc.

Remove the service oscillator output from the converter grid and couple it to the aerial and earth of the set. Set it to provide a signal at the low frequency end of the tuning range and then at the high frequency end, and go through the same coil slug and trimmer adjustment outlined previously.

An output meter coupled between the 6BV7 plate and chassis is handy for noting the "peaks" of the adjustments. Keep the signal level from the service oscillator down and turn the volume control to full-on. This avoids letting the AVC action of the set mask the adjustments unduly.

When you are quite happy about the alignment adjustments, it would be a very wise move to seal the coil and IF transformer slugs and the trimmer capacitor screws against accidental change in setting due to vibration.

REAR VIEW OF THE RECEIVER



This view will assist you to mount the major components in their respective positions on the chassis top. When mounting the trimmers on the tuning gang, see that the top plate is the one which connects to the gang frame.

While coil dope or any such liquid acetate is satisfactory for the sealing of the slugs, it is not suitable for the trimmer screws. With too liberal an application here, the viscous liquid may settle in between the trimmer plates and alter the dielectric constant sufficient to cause a change in capacitance of the trimmer, with consequent alterations of the alignment.

We would suggest that you adopt the method of letting a couple of drops of molten wax fall on to the places in question. It solidifies on contact and, if need be, can be removed easily. Ordinary paraffin wax or the wax out of old capacitors will do. It can be melted with the barrel of the soldering iron while being held over the trimmer or slug.

COLOR CODE FOR RESISTORS

VALUE	BODY	END	DOT
1.5 meg.	brown	green	green
1 meg.	brown	black	green
.5 meg.	green	black	yellow
.1 meg.	brown	black	yellow
.05 meg.	green	black	orange
.04 meg.	yellow	black	orange
5000 ohm	green	black	red
100	brown	black	brown

Generally speaking, you will not need to use a long aerial with this set for satisfactory reception in the metropolitan area. We found that 12 to 15 feet was sufficient to enable about 40 odd stations to be tuned in, the local stations being the loudest, of course.

Too long an aerial can introduce "cross-modulation," a condition open to sets without an RF stage and operated in the service area of one or more very strong stations. The effect is manifested by a heterodyne whistle on every station tuned in, excepting the very strong ones, or by one station being heard faintly in the background, irrespective of the station to which the set is tuned.

Outside the metropolitan area, this condition would not normally exist and a long aerial can be used to advantage.

The remaining job is to fit the set into the cabinet. You will note that the dial lamp and holder extend a little beyond the face of the dial glass. It should be let into the cabinet to allow the dial glass to come up against the escutcheon. It is a simple matter of marking the spot concerned and carefully cutting around to lift out two layers of ply in the 3-16th-inch ply front.

The area of the cabinet inside front allocated to the speaker should be built up with cardboard, plywood, canite or suchlike, to provide some effective baffling for the speaker. It can be attached either to the speaker or to the cabinet inside. Allow a cut-out of 4½ inches diameter for the speaker cone.

Corrugated cardboard is handy because, by making it a shade on the full side, it will compress a little when the set is pushed into place. What's more, it's easy to cut and trim.

Here's your answer, Tom!

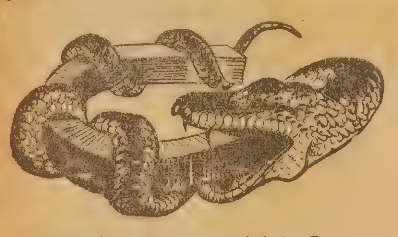
With a different Tom responsible for each of the queries this month, we can be sure of covering a wide variety of topics. In fact, the questions go all the way from blue-glowing valves to connecting headphones to receivers, with even a bit about snakes sandwiched in the middle.

I recently sent my radio to a serviceman to be repaired. He put a new valve in it but the new valve has a blue glow near the top which the old one did not. Do you think that he has sold me what is actually a secondhand valve from somebody else's set?

No, Tom, we feel it likely that the serviceman is quite honest in this case.

Some valves, particularly output or other power valves show a purple light near the glass envelope. Often the light flickers in sympathy with the signal. Fluorescence, as this phenomenon is generally known, is often an indication of a good vacuum in the valve which is all to advantage.

Don't confuse fluorescence with the dense milky-blue glow extending throughout the envelope which indicates a gassy valve. If the latter should happen to be the case, we suggest that you take the set back to the serviceman for a further check.



What is a magno-strictor?

We frankly admit, Tom, that this is a new one on us. Our artist, versatile as usual, turned up with the drawing reproduced here when the question was put to him. It would seem that he feels that there is some connection between a magno-strictor and a boa-constrictor, in which case the best we can suggest is that you consult a zoology expert.

In radio the nearest thing we can think of is a magneto-striction oscillator. This particular type of oscillator depends for its operation on the fact that when a magnetic material conducts a magnetic flux it changes its size. A magnetic oscillating system can be coupled to a radio valve which supplies the power for keeping the oscillations going.

While the phenomenon is apparent in materials such as iron and steel it is most marked in the case of nickel. Devices employing the principle of magneto-striction have been used to generate and radiate supersonic "sound" waves, particularly in under-water detection systems.

As I was tuning our radio the other day, I noticed some morse code signals which appeared to be all over the broadcast band. Could you tell me how this could happen?

SIGNAL FROM SHIP

As your particular location is within a few miles of a busy shipping route it is possible that you heard a signal from a ship's transmitter. If an extremely strong signal is applied to the aerial terminals of a radio set under certain conditions, the set will respond to them despite the fact that it may not be tuned to the frequency of the signal. The effect is usually more pronounced if sharp cut-off rather than remote cut-off valves are used in the first stages of the receiver.

Another possibility is that a ship was using an emergency spark transmitter. Spark transmitters emit a very broad signal so that receivers tuned many Kcs away from their frequency will respond. For this reason they are only used on ships nowadays when the regular transmitter is not available.

A violin string, organ pipe or vocal chord can only vibrate at a single fundamental frequency plus harmonics. How is it then that the single cone of a loudspeaker can reproduce a low organ note and a high violin note at one and the same time.

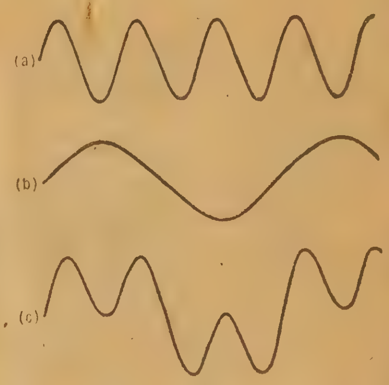
This particular question, Tom, is one which can be given a much more convincing answer with the aid of some diagrams. Accordingly we have used the space usually occupied by one of our artist's facetious sketches for something more serious.

GRAPHICAL EXPLANATION

At (a) is a graph representing a high pitched note from, say, the violin. The vertical axis represents amplitude while the horizontal axis represents time. You can see that in the amount of time represented by the width of the diagram the violin string has been able to execute a little over 4 complete oscillations.

At (b) is illustrated a note from another instrument, say, an organ. Note that in the same amount of time it only completes a little over one oscillation.

Now when these two notes are superimposed, as is the case when the signal originating from the violin and the signal originating from the organ are fed through an amplifier, the result is the signal shown at (c).



This signal contains all the intelligence of both signals. In fact, if you were to provide suitable filters it would be possible to separate it into its original components again. If you were to listen to the signal at (c) reproduced by a loudspeaker you could mentally "filter" the program by listening to the violin or the organ only, according to your tastes.

You can prove the validity of the graph at (c) for yourself by algebraically adding two or more simpler curves.

Divide the horizontal axis of the graph up into convenient portions of time and then find the amplitude of each of the constituents at a particular time. For example at one time instrument A may have amplitude plus 4. At the same time instrument B may have amplitude minus 1. The resultant therefore is plus 3.

METHOD OF PLOTTING

Consider the same problem at convenient time intervals throughout the period being studied and by this means you will establish a series of points representing the resultant amplitude. Provided the points are not too far apart a smooth curve drawn through the points will be a good estimate of the resultant signal. Sometimes you will get some very surprising results.

In practice both the components and the resultant are usually very much more complicated than the examples given by us mainly because of the presence of the various harmonics which give character to different instruments.

Whatever the outline of the signal the cone of the speaker attempts to follow it. We say "attempts" because in a practical loudspeaker there is a limit to what the cone is capable of doing.

Do I need any special test apparatus to build one of Radio and

Hobbies' push-pull amplifiers? If I were to build a push-pull amplifier without test apparatus, would I be likely to have ¼ push and ¾ pull, or some such effect because of the components not being properly balanced?

Most of the push-pull amplifiers which have been described in Radio and Hobbies obtain the out-of-phase drive for the output valves from some form of resistive dividing network. Sometimes the grid resistor of the upper valve is tapped, the tap being connected to the grid of a triode amplifying valve, which is, in turn, resistance-coupled to the grid of the lower valve.

The position of the tap is adjusted so that the drive on both valves is equal, and the triode element is included simply for the purpose of providing the out-of-phase drive.

PHASE SPLITTER

Another system which has certain advantages over the previous one depends on a split load resistor, one-half of which is connected into the plate circuit, the other half being connected into the cathode circuit. The out-of-phase drive for the output valves is obtained via a pair of blocking condensers from the plate and cathode respectively of the phase-splitter valve. Usually a cathode bias resistor for the phase-splitter is included, but this does not affect the fundamental operation of the system.

Most resistors for radio purposes are made to a tolerance of plus or minus 10 pc. Cheaper varieties have a tolerance of plus or minus 20 pc, but these would not normally be considered in a push-pull amplifier anyway.

In the worst possible case, one of the resistors could be 10 pc high in value and the other 10 pc low, with a corresponding out-of-balance in the drive applied to the output valves. Without analysing the situation mathematically, this would result in a very slight decrease in the maximum power output available for a given distortion figure or, to put it another way, for a given figure of power output appoaching the maximum the distortion would be slightly greater.

Push-pull amplifiers employing resistance coupling are invariably operated under either class A or class AB1 conditions. Now, a class A or class AB1 amplifier will operate in a single-ended circuit without excessve distortion, as you can prove by removng one of the output valves. Furthermore, the difference in volume observed by ear with only one valve working is not so great as instrumental observation would suggest.

ADVANTAGES OF PUSH-PULL

Of course, push-pull has a number of advantages over the ordinary single-ended amplifier. Not only is the power output greater, but there is a tendency for any second harmonic distortion to cancel. A further advantage is that the current is flowing in opposite directions through the two halves of the primary, removing the tendency for magnetic saturation of the output transformer core.

Out of all that, Tom, we would advise you to go ahead and use ordinary 10 pc tolerance resistors unless you are especially fussy, in which case you could pick out a matched pair from a stock of resistors, or otherwise order a pair of resistors with low tolerance.

In the case of class AB2 or class B amplifiers, the drive is almost invariably obtained from a transformer because it is necessary to have low resistance between grid and earth circuits. You are then in the position of relying on the workmanship of the transformer manufacturer for correct balance of the secondary winding.

To make absolutely cetain that the drive is balanced, you need a vacuum tube voltmeter, or, better still, a cathode ray oscilloscope. Both instruments are usually included in the designer's laboratory, but if you are following a tested design such as one of those published in Radio and Hobbies, they would not normally be necessary.

Could you please tell me how to convert picrofarads to microfarads?

Simply take the number in picrofarads and divide it by 1,000,000. For example:

$$100\text{ pf} = \frac{100}{1,000,000} = .0001\text{ mfd.}$$

For convenience we generally use pf for values up to 999 pf and mfd for values of .001 mfd and above.

If you were to put earphones on to, say, a three-valve set, what would happen to the earphones. If they are in danger how could damage be avoided?

You can connect headphones to a 1, 2, 3 or 13-valve set if you wish, Tom. With some methods of connection it might even be possible to damage the 'phones by connecting them to a 1-valve receiver.

The important points to remember about headphones are that they are not designed to pass high values of direct current and the amount of power that they are capable of handling is limited.

In the case of very small sets the high tension current of the output valve is only a milliamp or so and the power output is usually very small so that it is convenient to connect the 'phones directly in series with the plate lead of the valve.

It is true that the continuous flow of direct current through the phones could have a detrimental effect on the magnets, but if the current is sufficiently small, this is likely to be negligible.

PROTECTIVE METHODS

However, a better method is to insert a transformer primary in the plate circuit of the valve and then connect the secondary of the transformer to the phones. Not only does this avoid the need for passing direct current through the phones and isolate them from the high tension circuit but the ratio of the number of turns on the primary and secondary of the transformer can be arranged to provide a correct match between the valve and the headphones.

Failing a transformer, a choke can be inserted in the plate circuit of the valve. The headphones can then be connected to the plate circuit of the valve via an isolating condenser, the second lead of the phones being connected to earth. In practice it is a good idea to connect a hight value resistor across the phones to dis-

(Continued on Page 112)

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FROM THE SERVICEMAN WHO TELLS

With the approach of the warmer weather the younger members of the community are taking their portables out of mothballs and giving them a trial run before the season really gets under way. Or at least so it would appear from the way they have been trickling in for service over the last few weeks.

Mostly they require little more than a new set of batteries and a general clean up around the battery contacts, this last point indicating the need for greater care in the matter of batteries than many owners apparently realise.

It seems that a lot of people still fail to appreciate that a so-called "dry" battery is not dry at all, but merely a convenient packaging of a wet primary cell, the dry characteristic being simply due to careful sealing and the use of pastes and jellies rather than actual liquids.

CORROSIVE CHEMICALS

Thus, if anything happens to break the seal of these batteries, the chemical "goo" is free to ooze all over adjacent objects and cause considerable mess. Worse than the mess, however, is the fact that it is mildly corrosive and will attack most metals to some extent, leaving a deposit of white powder and a pitted surface where it was once well finished.

When a dry cell is approaching the end of its useful life, there is considerable expansion of the active materials, as well as a weakening of the zinc outer container due to chemical action, and this combination of conditions very frequently results in the release of corrosive chemicals.

Being in a jelly form they do not immediately flow onto their surroundings, while their progress is still further retarded by the cardboard outer casing. Nevertheless, it is only a matter of time before these obstacles are overcome and the sticky goo is free to do its destructive work.

Where the user follows the maker's instructions to discard the battery immediately it is discharged, there is little chance of trouble, for the slow progress of the chemicals, as outlined above, provides an adequate safety margin.

What frequently happens, however, is that a set of discharged batteries is left in the set from the end of one summer to the beginning of the next and the resultant mess can take quite a lot of cleaning up. In some cases, where the battery space has been kept to a minimum, the swollen batteries will be firmly wedged in their compartment and need to be prized out with care.

ACTUAL CASE

As you have probably guessed, all these words of wisdom have been prompted by one particularly bad example of just how much damage can be caused by such carelessness.

In this case, the owner complained that the set had suddenly "gone heavy" on filament batteries, a set giving less than a couple of hours' service instead of the usual four or five hours. His story was that he had used the set for the first time after several months of idleness and had replaced the filament batteries which appeared to be dead.

The set then worked quite normally for two outings, a Saturday and a Sunday, after which it had been put aside until the following weekend. It was then discovered that the batteries needed replacing again, which was done, the owner not paying a great deal of attention to a single case and considering the possibility that the set had been used longer than he realised.

However, the second set of batteries gave even less service, the set being used only for about half an hour on one outing and again being put aside until the following weekend when it was again found that the batteries were flat. It was at this stage that the owner realised that something was really wrong and brought the set to me for an overhaul.

NORMAL CURRENT DRAIN

It was a typical commercial personal portable, using a miniature 67.5 volt HT battery, and two ordinary torch cells in parallel for the filament circuit. These latter were certainly finished, showing less than one volt each, but the set performed quite normally when I connected it to a set of test batteries on the bench.

The current drain was around 250 mA, which is the normal drain for these sets, and in this regard there appeared to be no reason why the batteries should not give normal service.

Next check was for leakage current with the set switched off and this gave the first lead to the trouble, for there was a steady drain of nearly 5 mA, a leakage which would just about account for the normal life of a battery over a period of six or seven days. Next point, of course, was to discover just where the leakage was occurring.

As usual, the negative contact was mounted directly on the chassis, while the positive circuit went via the switch. At first, I considered that the switch migh be at fault, but on disconnecting the lead from it the leakage remained, indicating that the only place the trouble could possibly be was the battery holder, since there was nothing else connected to the battery.

More detailed examination of the battery holder revealed that the leakage was definitely between the positive spring contact and the metal chassis to which it was fastened and that the leakage increased when the pressure was exerted on the contacts, as when the batteries were in place.

The spring contact was riveted to the chassis, a piece of composition material being used as an insulator and, since it was not a direct breakdown, it seemed certain that this was the cause of the trouble. I removed the rivets and examined the material more carefully. There was a distinct stain, which indicated that liquid of some kind had been spilt on it and, in fact, there was still a feeling of dampness about it.

It was at this point that I noticed signs of corrosion on the positive and negative contacts and also on the chassis in the vicinity of the battery holder. Admittedly all these points had been cleaned up very thoroughly, but there is no mistaking the signs of a battery which had been left in its holder after being completely discharged.

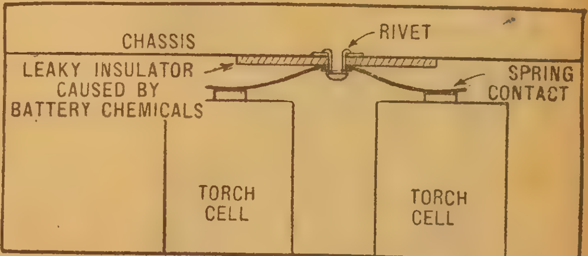
PROBABLE HISTORY

It was now becoming fairly evident what had happened. At some time, probably during the winter months, the set had been left standing with a discharged battery in it long enough for the latter to spill itself over everything in the immediate vicinity.

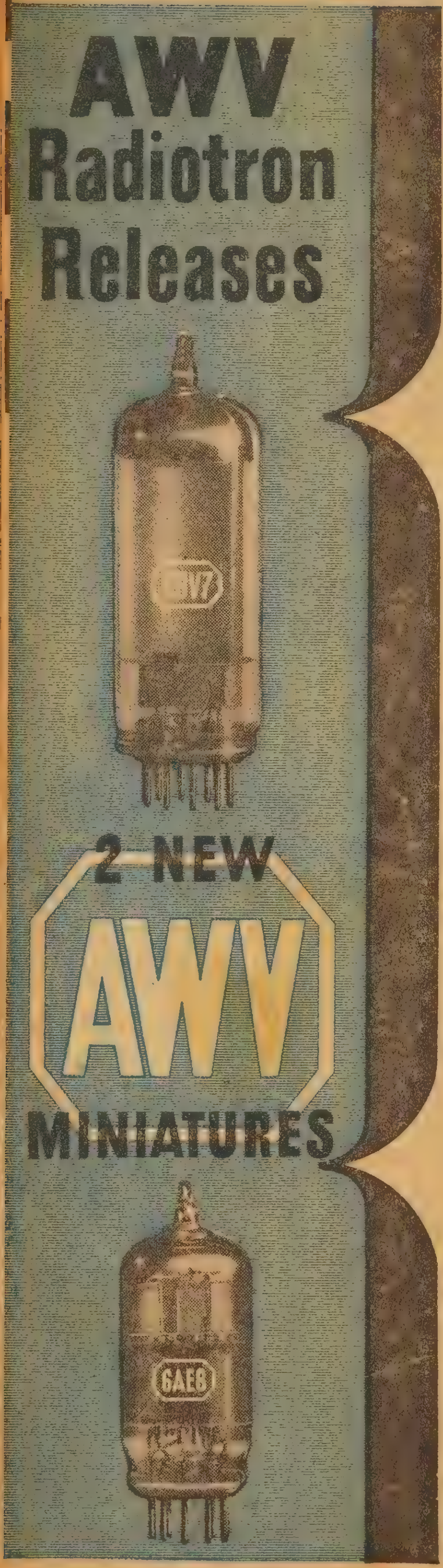
When the owner had come to use the set again it was probably in something of a mess, necessitating a general clean-up before it could be used. While he (or someone) had performed this task with commendable efficiency they had not realised that the insulating material had also been effected and that the solution which it had soaked up was a conductor.

Repairs consisted of replacing the composition insulator with a piece of good quality bakelite and reassembling the contact onto the chassis with new rivets. When this was done a careful check failed to reveal any measurable leakage even on the 1 mA range.

Finally, when the owner came to collect the set, I asked him to con-



A set of discharged batteries left in a set for several months saturated the insulator with chemicals and caused additional drain on the batteries. Since the drain was continuous it quickly discharged a new set of batteries.



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firm my suspicions and he admitted that, in the main, they were correct, the set having been left standing most of the winter with batteries which he realised were virtually exhausted the last time he used them.

While the fault in this case was mainly the owner's for not taking proper care of the batteries, the set manufacturer cannot be completely absolved from blame for the composition used as an insulator was of poor quality for a job like this.

While the maker may argue that it would have been quite satisfactory but for the carelessness of the owner, it must be realised that such accidents will happen, in spite of warnings, and it is up to the maker to make his set as foolproof as possible.

The second case I have selected for this month involved a set which was a far cry from the tiny personal portable, being a super monster which, in its day, was undoubtedly designed to be the most impressive receiver ever built. It seemed to have more of everything and bigger everything than any set I had ever seen, though this may simply have been a reaction from the personal portables.

EVERYTHING BIG

The audio end was an impressive push-pull affair, while the IF channel boasted two stages and was preceded by a dual-wave deck complete with RF stage.

The chassis, the power supply, the cabinet, and the dial were all built on generous lines, the dial being the particularly impressive type referred to in its day as a "full vision aeroplane dial." Yes, it had plenty of everything, and I include in that the faults, for it was one of those jobs to which there seemed no end.

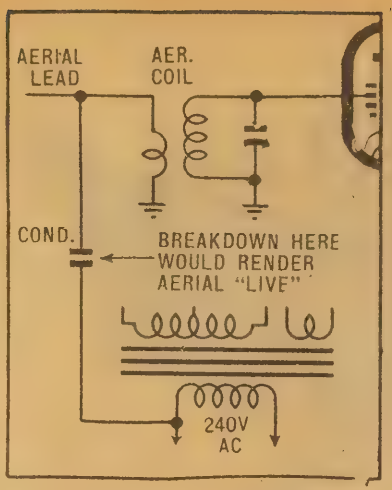
As you've probably gathered, it was not a modern set, being one of the early attempts at a really "hot" dual-wave receiver; a reputation it was no doubt able to uphold when it was functioning properly. Now, however, it was far from perfect, suffering from distortion, hum, lack of gain, "birdies," intermittent spluttering noises and, in fact, everything in the book.

One fault was immediately obvious. The filament of one of the output valves was not alight and the ohmmeter confirmed that it was open circuit. Its companion tested "good" and when the faulty one was replaced a proportion of the hum and distortion disappeared.

INTERMITTENT BREAKDOWN

Next the spluttering claimed my attention, mainly because it chose this moment to turn on a particularly good display. It was accompanied by fluctuations of the HT voltage, seeming to suggest that there was an intermittent breakdown from the HT line to chassis. However, it was the type of breakdown which only showed when normal voltage was applied, there being no indication of excessive leakage across this part of the circuit when it was measured with an ohmmeter.

Faults of this type sometimes call for drastic measures and, on the assumption that the faulty component would have to be replaced anyway, I could see no objection to destroying it completely, if necessary, in the process of tracking it down. To this end I decided to raise the voltage on the HT line in the hope that the breakdown would become complete and thus identify itself.

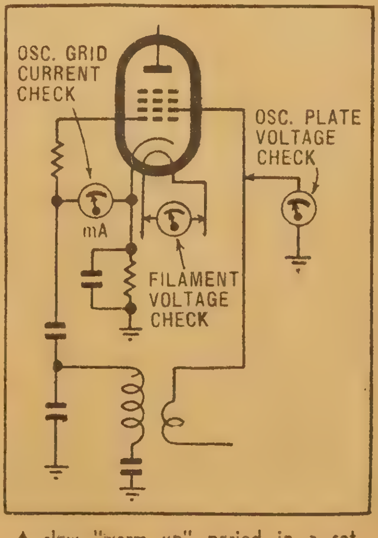


In this circuit the "aerial" is provided by means of the small coupling condenser to one side of the mains. As well as being an inefficient aerial, such arrangements are extremely dangerous if the condenser should break down.

This was very simply achieved by first removing one of the power valves and then both of them, keeping a close check on the HT voltage while doing so. It did not rise sufficiently to threaten the electrolytics, but the voltmeter began to kick violently while my attention was drawn to a sound of arcing near the second IF transformer. After a few seconds of this the voltage dropped to a low value and remained steady, indicating that whatever it was, it had now comlpetely broken down.

RESISTANCE CHECK

Guided by the sounds of arcing, I commenced a resistance check in the vicinity of the second IF transformer and after isolating various parts of the HT line traced the trouble to a short length of shielded wire which connected the last IF primary to the AVC diode, the insulation having broken down between the inner conductor and the outer shield.



A slow "warm up" period in a set, coupled with a sudden burst of signal, usually suggests a sluggish oscillator circuit. The tests for such a condition are shown here.

With this replaced, the set functioned reasonably well, but there was still an annoying hum level and a bad hetrodyne when tuned to 2GB.

I decided to tackle the hum first. It did not take long to establish that this was not coming from the amplifier section at all, but rather from the speaker field, the speaker being one designed before the days of hum-bucking coils. The filter circuit was a two-stage affair, using a choke as the first section and the speaker field as the second section, but, in spite of the preliminary filtering by the choke there was still sufficient ripple in the field to cause hum.

EXTRA "C"

Objectional though it was, it hardly seemed to justify a new speaker, so I decided to try the effect of some extra capacity at the junction of the choke and the field. This proved very effective, two 16 mfd electrolytics, in addition to the 8 mfd already in this position, proving sufficient to reduce the hum to a low level.

Next point was the hetrodyne. It seemed probable that an alignment check might throw some light on the problem and this, in fact, proved to be correct. At some stage someone had apparently attempted to align the set without the aid of an oscillator, and while they had certainly succeeded in putting all the IFs on the same frequency, it unfortunately happened to be the wrong frequency, being much lower than the usual 455 Kc.

With the IF channel correctly adjusted and the oscillator, RF, and aerial stage peaked up, there was no sign of the hetrodyne, while the gain was now really good, as one would expect from such a circuit. At least that's how it was on the broadcast band. The shortwave section was another story, having a very poor overall performance.

The trouble seemed to be located in the RF stage, there being practically no gain between the grid and plate of the RF valve. The valve itself tested good, which was rather surprising, since all the valves were apparently the originals and must have been at least 15 years old. The plate voltage was slightly less than the main HT line, but this seemed to be due to a decoupling circuit buried somewhere in the innermost depths of the chassis, and which I didn't feel inclined to disturb if I could avoid it.

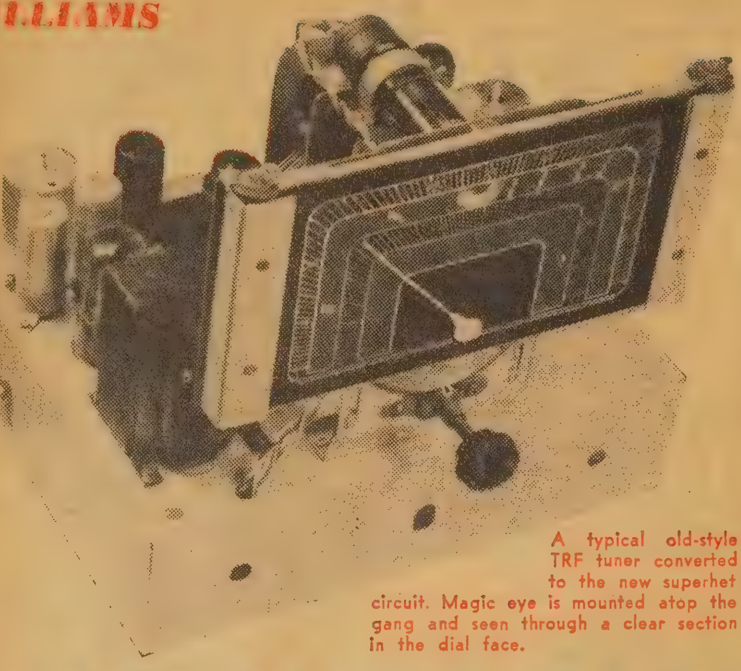
COMPLETE FAILURE

Fortunately, what looked like a possible sticky fault solved itself by the simple process of going completely dead when I happened to switch to the broadcast band and back to the short-wave again. This time there was no plate voltage on the RF valve and the cause of this was eventually traced to the primary winding of the RF coil.

But there was more to it than a simple open circuit. Examination of the winding revealed that there were several points of corrosion on the fine wire and that they lay in a straight line, indicating that there was a streak of impurity in the coil former which had attacked each turn in approximately the same place. It was also most probable

(Continued on Page 95)

BY W. N. WILLIAMS



A typical old-style TRF tuner converted to the new superhet circuit. Magic eye is mounted atop the gang and seen through a clear section in the dial face.

MORE ABOUT WIDE-BAND TUNERS

During the past month, we have constructed a second wide range tuner, using components completely different from those selected for the first (and standard) version. A discussion around this second tuner is presented as a possible aid to those who may wish to revamp existing equipment. A few additional and important points have emerged from the project.

OUR experience with this second tuner has fully confirmed our reaction to the first—it is the best and simplest tuner system we have ever described and is a fitting companion to the "Playmaster" series of amplifiers.

Reproduction is noticeably brighter than from a comparable TRF, yet it receives all the local stations cleanly, with a few of the stronger distant stations sandwiched in between. Alignment presents no difficulty whatever.

SIMPLE IDEA

As explained in the previous article, the principle behind the tuner is quite simple.

It is basically a superhet with an IF channel at 1.9 Mc rather than the usual 455 Kc. The use of this high intermediate frequency helps to minimise attenuation of sidebands resulting from the higher modulation frequencies. Broadly speaking, if the intermediate frequency is stepped up four times, the pass-band will also be widened in roughly the same proportion.

At the same time, by carefully controlling the "Q" factor and coupling of the four IF transformer windings, quite good rejection can be had of signals adjacent to the desired one.

So much for the IF channel, but it is still necessary to provide an aerial tuned circuit for discrimination against the image or other unwanted signals.

An ordinary aerial coil would itself be too sharp at the low frequency end of the band, undoing much of the good accomplished in the IF channel. To avoid this difficulty, two coils are used in a so-called "band-pass" circuit.

Properly aligned, they produce a definite double-humped response at the low frequency end of the broadcast band. Combined with the selectivity curve of the IF channel, the overall result is something approaching a rectangle with steeply sloping sides.

At the high frequency end of the band, the curve has a somewhat more rounded appearance but there is little difference in the audio quality. The response curves speak for themselves.

This second tuner was built originally by the writer without any special idea of being mentioned in the columns. It was intended purely to replace the "old faithful" TRF, which was mentioned many moons ago under the heading "My Personal Receiver."

Since the cabinet has long been arranged to house the said tuner and its friction-drive dial, it was a lot more convenient to retain the same physical dimensions than to cut and patch for something completely different.

Two or three other members of our staff find themselves in precisely the same position and, already, letters have come to hand from readers asking "what about it?" Can I convert my old tuner . . . can I use the existing valves . . . and so on.

Well, you can!

NEW COIL KIT

At the outset, you will have to make up your minds to buy a complete new coil kit, involving the aerial, bandpass and oscillator coils, the padder, two 1900 Kc IF transformers and the whistle filter coil—though this latter could be made to instructions already published.

Existing aerial and RF coils may or may not work in a bandpass arrangement. Until we get round to investigating the matter, we have no indication whatever as to what degrees of coupling would be required or what the resultant curve would look like.

The ordinary 455 Kc oscillator coil and padder will definitely not work because it is designed for an intermediate frequency of 455 Kc.

The circuit would obviously lose much of its point if the IF channel were run at 455 Kc, because the selectivity would be too high and no great improvement would be apparent over a standard receiver.

No, you must use 1900 Kc and preferably the transformers designed for the job. Standard 1900 Kc transformers would probably be fairly close to the mark but the precise results would depend a good deal on just what their coupling and "Q" factors happened to be.

OTHER PARTS

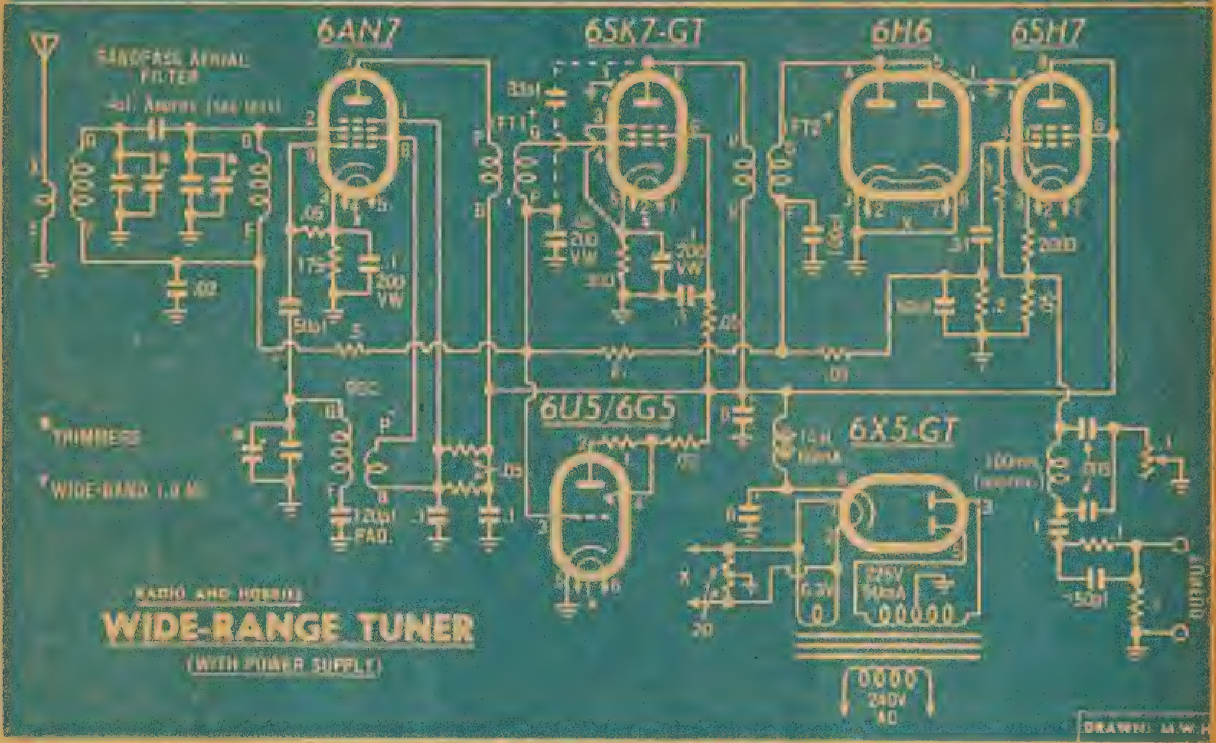
If you take our advice you'll settle for the proper coil kit, which should be available by now in at least two brands — possibly more. At the time of writing we're trying to anticipate production schedules &c.

As for the rest of the parts, the scope for variation is very wide indeed.

Any ordinary 3-gang can be used,

CONVERTING YOUR OLD TRF TO THE

TUNER CIRCUIT ADAPTED FOR ALTERNATIVE VALVES



The complete circuit diagram redrawn to illustrate the use of alternative valve types. Note the provision of power supply and magic-eye tuning indicator. Note also the compensated output circuit, which is a worthwhile addition.

provided it is in good condition and has a maximum capacitance rating around the 400 pf. mark. The one actually used in the above tuner is an old Stromberg type "D" gang minus about an inch off the rather cumbersome shield plates between sections.

It was stripped down, cleaned, painted over with grey enamel and then put together again.

The dial, as mentioned earlier, was an old 0-100 friction drive type, on which we hand-lettered the local station call-sign with white enamel.

Any suitable gang-dial combination can be used, provided the two are made to go together. With the slugs and trimmers it should be possible to make the new coils track quite close to the original station markings, even though everything about the circuit is so different.

ORIGINAL CHASSIS

The chassis shown in the photograph measures 11 x 9 x 3 inches. There is nothing special about these dimensions, except that the chassis happened to be available and, with the aid of a few cover plates and a spot of filing, it was readily converted to the layout requirements. It takes the gang and dial conveniently and allows the other components to fall into favorable positions.

We have no intention of making a blueprint available for this layout but the photographs have been coded as a guide to anyone who may wish to adapt similarly an existing chassis.

The golden rule is simple . . . "Keep all grid and plate leads short in the RF and IF sections; keep the audio leads away from AC wiring."

Well, now, what about the choice of valves?

We used a 6AN7 converter, mainly because one happened to be available and the single-ended construction is easier to use with midget coils. As a result, the circuitry round the converter is essentially the same as in the original tuner.

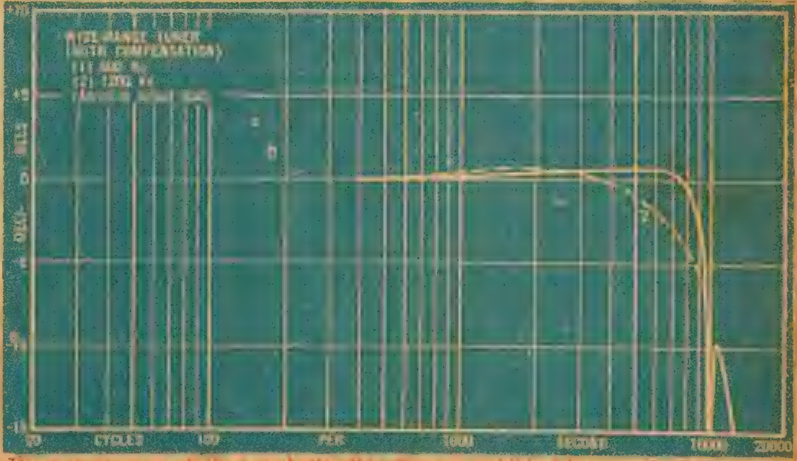
There is no valid reason, however, why similar results could not be obtained from valves like the 6J8-G, the ECH33 or ECH35 or the X6IM. If you happen to have one of the other small converters on hand, so much the better. In a broadcast receiver, it is most unlikely that an one of them will refuse to work wit a 6AN7 oscillator coil.

Simply keep the grid lead as shor as you can, and modify the scree and oscillator plate feed as require to give a suitable operating voltage.

When wiring in the aerial an band-pass coils, make sure to kee the two "grid" leads well apart an down fairly close to the chassis. Yo can then proceed to add the "top coupling in the knowledge that it wi be fairly close to what was foun optimum in our laboratory.

We have experimented fairly care fully with this and found that th optimum coupling is given by tw strands of 7/.010 plastic hook-u

NEW DESIGN



This response curve looks even better than the one published last month. Differences are accounted for by a slight increase in the band-pass "top coupling" and by the output circuit compensation.

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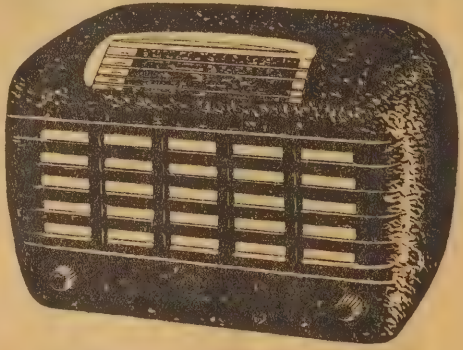

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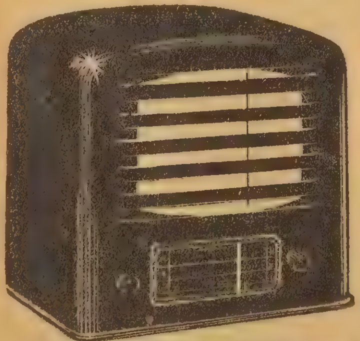

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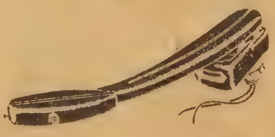

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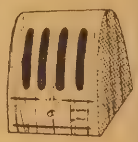

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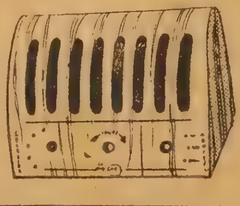

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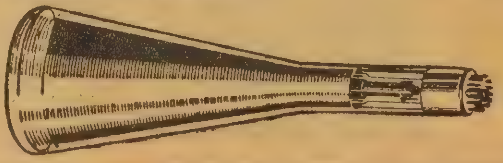

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twisted tightly over a distance of two-inches. This is slightly longer than suggested in the original article. Bend the "capacitor" in half and bind with cellotape.

Too little coupling doesn't push the "shoulders" on the curve quite far enough out. Too much coupling produces a peak in the middle and ruins the flat top.

This part of the circuit gave us no trouble at all but the IF channel did cause some worry at first and for no immediately apparent reason. Perhaps it is best to tell the story as it happened.

We didn't have a 6BA6 on hand and planned to use one or other of the normal "-GT" series.

The two possibilities were a 6SH7 and the 6SK7.

Of the two, the 6SH7 has much the higher gain, being roughly equivalent to the 6BA6 in this respect. However, it is a sharp cut-off type and not normally used with AVC. We reckoned that it might do the job if the screen were fed through a series resistor, rather than from a semi-fixed source. Anyway, we tried it.

INSTABILITY

Though everything seemed quite normal when roughly aligned on the air, the IF channel definitely approached instability when aligned on the generator. As expected, the audio pass band was very restricted under these conditions. At the same time, the selectivity curve was far from being symmetrical on either side of the peak.

To cut a long story short, we traced this effect back to the combination of a high GM tube and the grid-plate capacitance across the octal socket. The effect was eliminated completely by running a shield between the two cathode and G3 pins, of shim brass about 3/8in high, sufficient to enclose the plate lug on the socket. This simple scrap of metal made all the difference between an IF channel which was unstable and unsymmetrical and one which did everything expected of it —or nearly so!

While such a precaution would not normally be necessary with the 6BA6, as in the original receiver, it does stress the absolute necessity of keeping the IF plate and grid leads part and as short a possible. If your IF channel is unstable or unsymmetrical in its response, look to this point.

RESONANCE CHANGE

Another difficulty we struck was an apparent change in IF channel resonance with varying amounts of signal input. The channel could be lined up accurately on a weak 1900 Kc signal, only to show maximum output on about 1907 Kc when the signal amplitude was stepped up by a 100 times.

It appeared that this was due simply to "Miller" effect changing the apparent input capacitance of the IF amplifier tube and detuning the secondary of the first IF transformer—normally the winding with the highest operating "Q." "Miller" effect, in turn, is a function of stage gain and grid-plate capacitance.

Using the 6SH7, we evolved a simple cure in neutralisation. It merely involved the connection of a 33pf condenser between the plate of the IF amplifier and the AVC bypass point in the valve's own grid circuit. By placing the components strategically and mounting the condenser near the plate pin, no trouble was experienced with long or "hot" leads.

The condenser value was not particularly critical and our impression was that anything between 20 and 33pf would suffice, the IF slug simply being screwed out far enough to re-peak the circuit. With the neutralising in place there was absolutely no shift in resonance and the response curve was symmetrical.

Don't be scared off by this bit of circuit juggling. It is quite simple and the hint may be worth hours of unhappy fiddling for someone who may be tempted to use high-gain and relatively high-capacitance tubes.

As it was, the 6SH7 was operated with a 100-ohm cathode resistor and a 40,000 screen dropper from B-plus, giving a fairly good control characteristic.

On test, we found that the tuner would handle 100 pc modulated signals without distress up to some 30,000 microvolts, above which the IF tube was too near cut-off to amplify cleanly.

Of course, that represents a l of signal and the "five bob" 6SH7 a proposition as an IF amplifier you don't live too close to th stations or don't want to use tc large an aerial.

Rather than tolerate such a limitation, we decided in our own case have a look at the 6SK7, hoping tha its much reduced gain would sti be adequate for the job. The 6SK is, of course, representative of whole string of super-control R amplifiers having a Gm figu around the 2000 microohms mark.

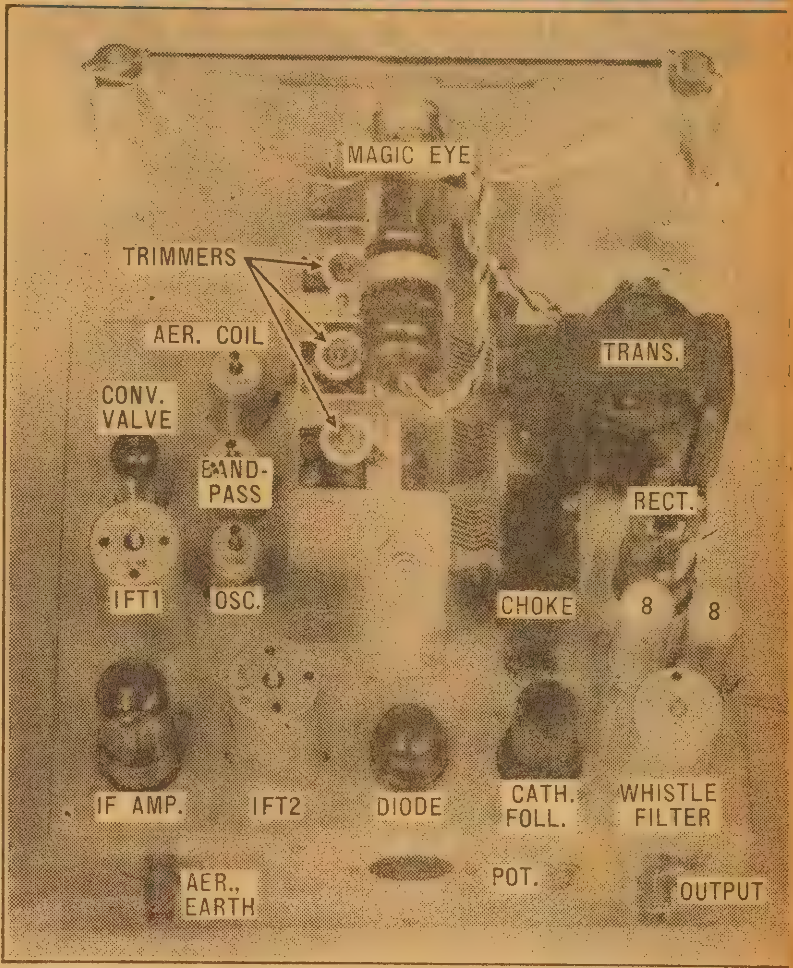
The gain is definitely down on th 6BA6 or 6SH7 variety of tube, bu there's still plenty for averag suburban listening. And there's n likely limitation on carrier strengt which is a good thing.

SOCKET SHIELD

We retained the little shield aroun the plate pin on the octal sock for the 6SK7 as being a good thin anyway. Due apparently to much re duced Miller effect, there was littl apparent tendency for resonance shi in the IF channel with large sign input, so that neutralisation woul not normally be regarded as neces sary.

We left the condenser in, mainl

VIEW ON TOP OF THE CHASSIS



Illustrating the layout of the major components above the chassis. Such a layout ensures short leads and a logical progression from aerial to output terminals.

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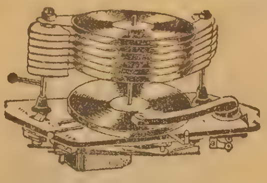

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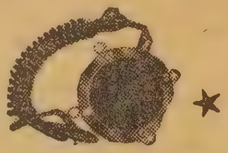

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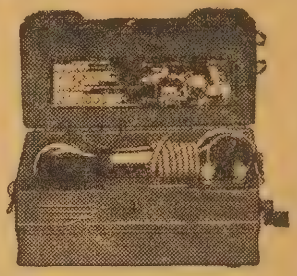

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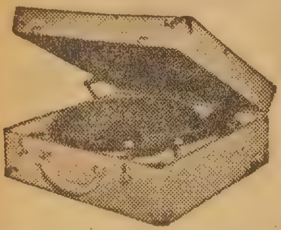

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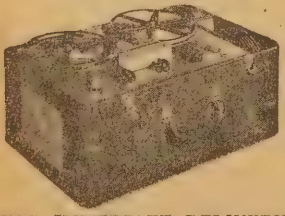

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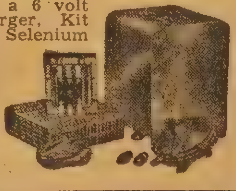

Kit of parts to build a 6 volt 4 amp. Battery Charger, Kit includes an English Selenium Rectifier, Transformer, black crackle finish metal case, two terminals, hook-up wire and circuit blue print instruction. Price, as illustrated, £5/19/-. 12 volt 2 amp. 5/- extra.

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because it was already there and it could have had a vestigial effect for good.

So that was that. Prospective constructors, who don't anticipate being pushed for the last vestige of gain, can safely use up an existing 6SK7 or a 6U7 or a 6SS7 or other such tube in the IF amplifier stage — but watch that grid-plate capacitance or it will wreck everything!

The screen and cathode condensers specified for the 6SK7 will do for most of the other RF pentodes of the same vintage.

Coming to the diode-cum-output stage, we were definitely averse to using a 12AX7. While the tube was the natural one to specify in a new design, as last month, it's not the type one will extract from the junk box to use in a broadcast receiver.

DIODE DETECTOR

Instead, we picked out a 6H6 "won" originally from an IFF set. Hundreds of these valves have been sold ex disposals, in the glass version, for 2/6 a time. Having two diodes available, we could have used a separate AVC system but the shunt considerations are so inconsequential that there was little point in so doing.

All you need therefore is a single diode and you can use anything in the socket that can be made look like a diode of reasonably low impedance.

Then the cathode follower, which is necessary to feed the whistle filter. To speak in the same terms, you can use any valve which can be made to look like a general purpose triode. We settled for a triode-connected 6SH7 and, by and large, the same circuit constants will do for almost any general purpose triode or triode-connected pentode.

The whistle filter circuit is the same as specified last month and calls for no comment. Only difference in this case was the use of a coil produced by a different manufacturer — for no other reason than to check its operation.

Coming to the actual output circuit of the tuner you will, however, notice a slight difference. Instead of being taken directly from the coupling condenser, the output is taken instead from the junction of two series resistors, one of which is bypassed. There is a definite reason for this.

As we hinted last month, the output from this tuner is normally quite high and some deliberate voltage division may be reckoned as worthwhile, to avoid critical manipulation of the amplifier's volume control. Immediately, as a sideline to this, there arises the possibility of compensating in this divider for the small amount of treble loss revealed by the overall curve published in the last issue.

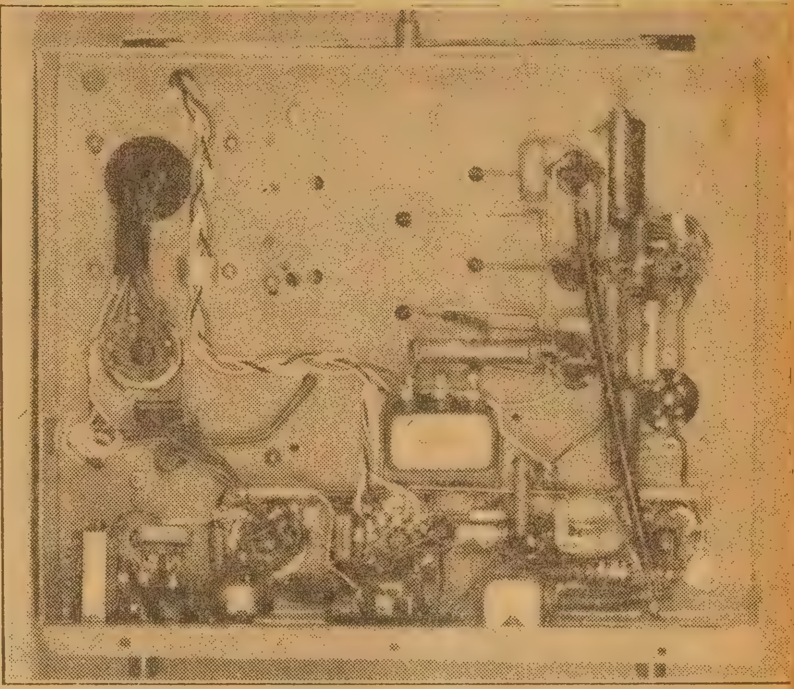
COMPENSATION

Once again, to cut a long story short, we selected two resistors and an associated condenser which would take up just where the IF channel begins to cut. It was "tailored" to fit the response at the low frequency end of the band where the main national stations are.

The effect was startling — in fact almost unbelievable! We had someone else check the instruments and the figures just to make sure, but there was no mistake.

We set the reference as 10,000 microvolts, 600 Kc and 50 pc modulation at 400 cps. This was at the aerial terminal, the tuner output being measured with a VTVM across the output terminals.

VIEW UNDERNEATH THE CHASSIS



A view under the chassis. All coils and sockets are positioned to ensure short grid and plate leads. A phone jack in parallel with the output terminals allows the use of phones with the tuner, also provides ready connection for other amplifiers.

The output rose gradually by 0.2 db at 100 cps to a maximum of 0.5 db at 5000 cps. It crossed the zero line again at 7500 cps to be down 0.4 db at 8000 cps. It was 2.8 db. down at 9000 cps and right out at 10,000 cps due to the action of the filter.

At 11Kc. we measured the output as minus 12 db. dropping steeply thereafter due to the selectivity of the aerial and IF channel.

Looking back over what has been said about the "ideal" response required of an AM tuner, it is hard to visualise anything closer to the classic prescription.

TUNING INDICATOR

We naturally can't guarantee that every tuner will give precisely the same results. The last decibel or two will come or go with variations in coil alignment and coupling, regenerative effects in the IF channel, variations in signal strength and frequency — even limitations on the accuracy of measuring equipment.

But these remarks apply with equal force to all tuners, superhet and TRF.

Not a word about the tuning indicator. With a brood tuner, especially one with a flat-topped response, it is more than ever necessary to tune carefully to ensure the best results. We developed the habit of tuning alternatively to either side of the station, listening for the signal to weaken, then putting the pointer into the centre position between the two.

To make things easier for non-technical members of the household, we fitted this second tuner with a magic eye. On the higher frequency stations it works normally, because

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e response curve remains slightly unded at the peak.

Down around 600 Kc the response flat but the eye makes it easy pick the region where the signal strongest, allowing the tuning to set quite accurately. The eye not by any means essential but it is definite help.

We fitted this tuner with a power pply also, mainly because we per- nally needed it that way. The mponent ratings are quite stand- rd and can be duplicated by any- e who similarly needs a tuner ith an in-built supply.

If you use small components and e of the miniature rectifiers — a 6X4 or a 6V4 — it should be possible to fit a power supply on to the smaller chassis used for the origin tuner.

Of course, if you have a "Playmaster" amplifier — other than the "Baby Playmaster" — the power supply will not be required, since the necessary heater and HT supply can be picked up from the amplifier itself.

The same can be done with other amplifiers which have a reserve of heater and HT current. In common with the original version, the tuner needs between 200 and 250 volts of HT at up to 20 milliamps, under average conditions. If the amplifier delivers more voltage than this from its HT line, it would be advisable to check plate, screen and oscillator anode voltages to make sure that ratings are not exceeded.

Alignment of the tuner is very simple. Begin by setting the dial for equal overlap at both ends of the scale.

If you have an oscillator or signal generator available and something to serve as an output meter, begin by aligning the IF transformers to 1900 Kc., peaking all slugs for maximum output on a fairly weak input signal.

Now sweat a 20,000 ohm resistor temporarily to the top of the gang in such a position that its free end can be touched alternatively across each of the aerial tuning sections.

THE SLUGS

Let the resistor rest on the first section, then tune a signal from the generator at 600 Kc. Pull the signal into its right position by adjustment of the oscillator slug and tune the dial accurately for maximum response. Now set the core in the band-pass coil which is NOT shunted by the resistor.

Without touching the dial, swing the resistor across the second section of the gang and peak the first slug for maximum output.

Now go to the high frequency end of the band and to a signal about 1200 Kc. The shunt resistor should not be used for these adjustments.

Tune the signal and bring it to its right position by adjusting the oscillator trimmer. Carefully tune the signal for maximum response, then align the two aerial tuning trimmers for maximum output.

Having completed this operation, repeat the whole procedure starting with the slugs at the low frequency end and finishing with the trimmers at the high frequency end.

If you haven't an output meter or oscillator, you can work with station signals and everything that will read around 10 milliamps. Connect a meter in series with the earthed end of the 6SK7 cathode resistor so that it reads the 6SK7 cathode current. This is a good measure of AVC voltage and therefore of signal strength.

Begin by tuning a station at the high frequency end, around 1200 Kc, and, without bothering about its exact dial calibration, peak the two aerial trimmers for minimum cathode current. Now touch up the IF transformer cores, also for minimum current.

THE COILS

This should put the IF channel very close to optimum. After that go through the alignment procedure as already set out, using the shunt resistor and a station near 600 Kc. to set the cores, and NO shunt and a station near 1200 Kc. to set the trimmers. Reduced cathode current means a stronger input signal. Run over the whole procedure two or three times till everything appears to be right on the dot.

If you have instruments whatever available, it will simply be a matter of working as above, using weak stations at either end of the band and relying on your ear to pick variations in signal strength as the adjustments are made. You won't be able to get things quite as accurate as if instruments were used but, with care, it should be pretty close to the mark.

A magic eye is a help of course, in that it does indicate signal strength.

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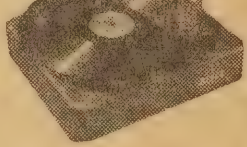

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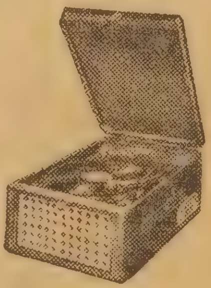

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A COURSE IN TELEVISION

PART 40—THE RCA COMPATABLE COLOR SYSTEM

Our last article on color television took the form of a general survey of the three basic methods of presentation: (1) Sequential color frames, (2) sequential color lines and (3) sequential color dots. This last method has been modified by RCA to give their compatable color system and further discussion of the method is warranted.

WITH any on the three basic color systems, the picture information must of necessity be contained in three separate video signals, one each for the red, green and blue versions of the scene.

The signals may be applied to separate carriers, or suitably modulated on to a signal carrier or time-switched but they must be capable of being separated out and interpreted by the color receiver.

Furthermore, the three basic color signals must each involve a relatively wide video band, if each is to produce the picture resolution represented by large color patches on the one hand and by abrupt color discontinuities on the other.

In this respect, for equal resolution, the video bandwidth demanded by each constituent color is not very different from that required by a complete black and white picture.

WIDER BAND

Or, to put things another way, the bandwith required by any basic system of color television—i.e., pure sequential frames, lines or dots—must be considerably wider than that required for a monochrome picture, unless the quality of the picture is allowed to suffer in other directions.

Despite this seemingly basic objection, however, the RCA engineers tackled the task of evolving a color system which would give a three-color image, be all-electronic and yet occupy no greater bandwidth than the standard, 6 Mc. black-and-white (monochrome) channel.

Furthermore, it was their objective to make the signal conform to the major specifications for such a channel, so that color signals could be received as a matter of course in a black and white on a standard receiver.

The commercial and practical value of such a scheme is self-evident and it is now a matter of history that the major difficulties have indeed been solved.

The electronic circuitry of a compatable color transmitter and receiver is considerably more involved than that in a more basic non-compatable system but this is offset by the fact that the signal is receivable on standard, inexpensive monochrome sets.

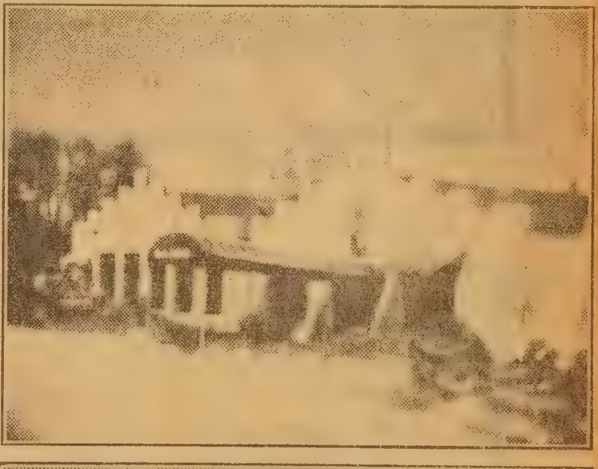
Indications are that the final results do not suffer at present by comparison either with mechanical color-wheel systems or original monochrome broadcasts.

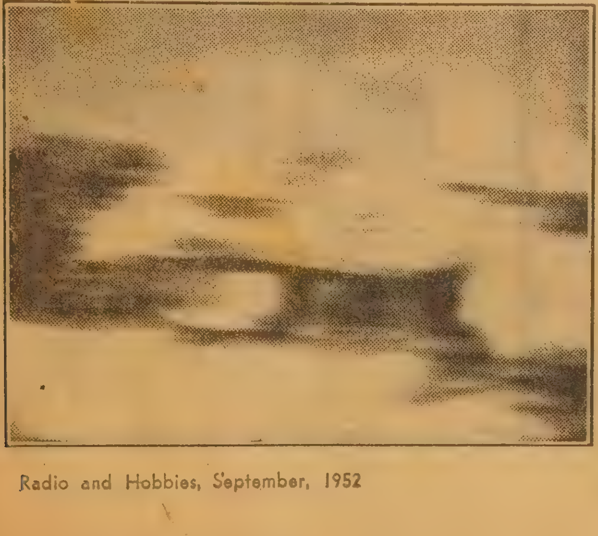
But how could RCA engineers manage to accommodate the picture "information" from three broad-band channels in a single channel? The principles can be explained in general terms along the following lines.

In each channel, the lower frequency signal components correspond to the relatively sustained areas of color, while abrupt changes and edges give rise to the high frequency components. Thus, in a video channel 4 megacycles wide, the frequencies from 0-2 megacycles may be regarded as defining color areas, while those from 2-4 megacycles would define image edges and outlines.

RCA makes use of this fact by interposing electrical filters in each 4 Mc. wide color channel to divide the "lows" below 2 Mc. from the "highs" above 2 Mc.

The "low" video frequencies for each color are transmitted to the receiver, with an obvious economy in overall bandwith, and these are transformed ultimately into red, green and blue color patches on the receiver screen. However, since





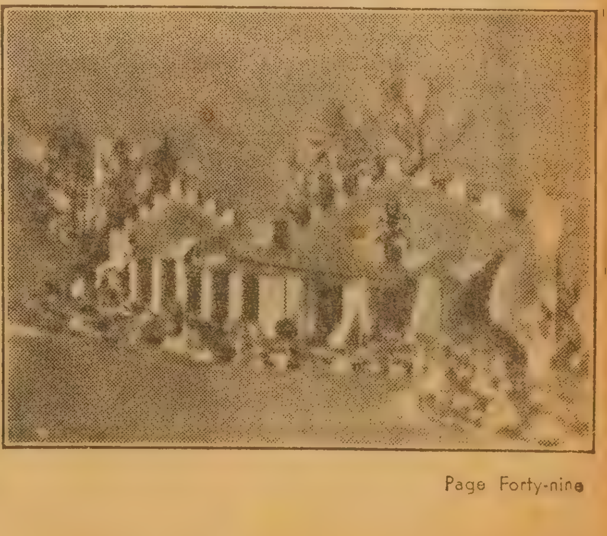


Figure 1: Only a detailed set of color plates could show adequately the build up of a picture using the "Mixed High" system. These halftone illustrations, however, are taken from color prints of a TV screen showing, at the right, the complete picture and below the constituent color patches and outline image. ("Electronics").

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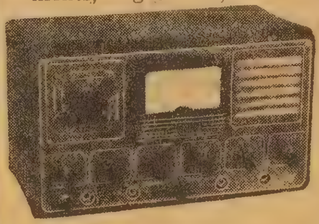

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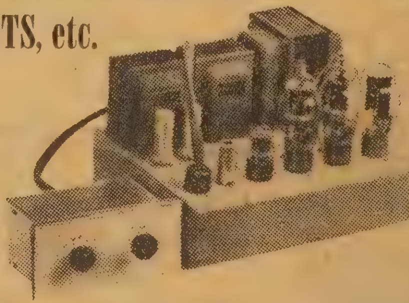

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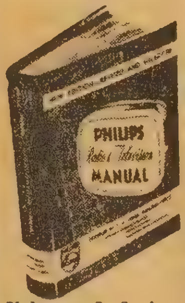

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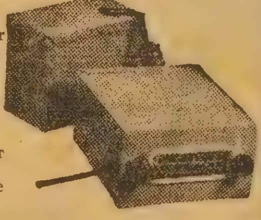

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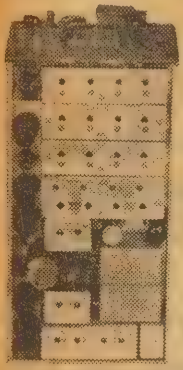

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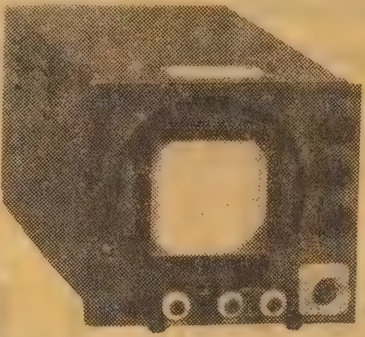

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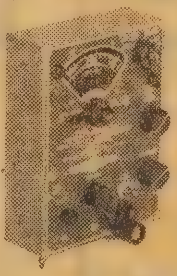

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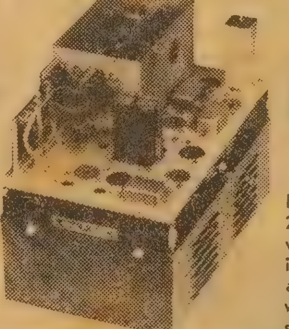

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the high frequencies have been filtered out, definition is poor and the factual color picture lacks sharp outlines.

However, that is only half the story. All the high frequency components, which have been filtered out, are deliberately combined at the transmitter to form a single high frequency signal containing "information" about outlines and edges. This "mixed high" signal is transmitted to the receiver (along with the separate lows) and fed simultaneously to all three color sources.

Thus, while each source is separately producing red, green and blue color patches, they are also forming simultaneous and overlapping outlines, which combine to give a black-and-white effect.

Thus, the overall picture is built up from color patches (from the low frequency components) which are "over-printed" by what is virtually a sharply defined black-and-white image.

(Actually the red and green, sources having the highest visibility factor, are the most significant in forming the "overprint" image and the "mixed high" signal need not go to the "blue" screen.)

COMPARABLE IDEAS

In this respect, the presentation is similar to "Technicolor" movies and certain systems of printing which combine a black-and-white printer with color plates.

Proponents of the system claim that the eye does not object to the "overprint." In fact, they go farther to suggest that the eye may itself not see outlines in color so much as in monochrome, due to sharp refractions from corners and edges.

Electrically, however, the value of the system is obvious in that it replaces three separate high frequency signals by a single high frequency signal. Then, by triggering the low frequency components so that they are sent in sequence—red, green and blue—the complete signal can be fitted to the bandwidth and to the major standards of the agreed 6 Mc. monochrome channel.

Figure 2 is a block diagram of the basic RCA system at the transmitter end.

Item 1 is the color camera, in which the image is split by dichroic mirrors so that the red, green and blue components are diverted to three separate picture tubes. The tubes operate with common frame and line pulses and each delivers at its output the relevant picture information in a video band approximately 4 Mc. wide.

"MIXED HIGHS" SIGNAL

Some of the energy from each channel is extracted and combined by "Adder No. 2," then passed through a high-pass filter. What is left is a combination of the 2-4 Mc. high frequency components, corresponding to what is virtually the monochrome outline image already referred to.

Meanwhile, the low frequency components are filtered from each color channel and pass to a "sampling" system.

The sampling system works like this: As the scanning spot swings across the subject, the output of each of the three color cameras is "tapped" about 3,800,000 times per second. Each of these sampling

DETAILS OF RCA COLOR SYSTEM

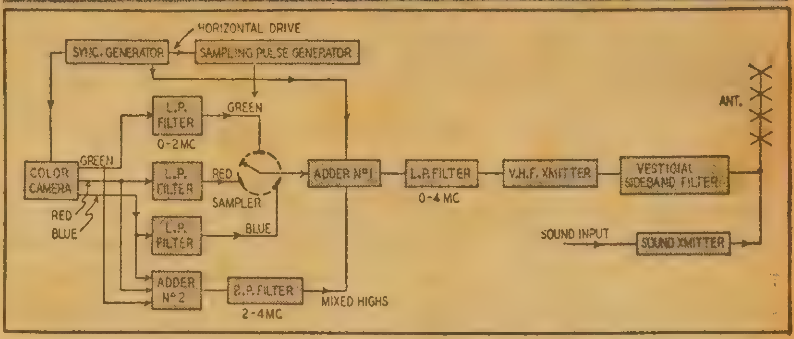


Figure 2: How the RCA system works at the transmitter end. In the receiver, all stages are standard to the video ouput. Here, a synchronised "sampler" extracts the "red", "green" and "blue" signal values and applies them to the color kinescope. Color areas are built up by the tubes operating separately but the "mixed high" signal on all tubes (blue can be excluded) provides a virtual black and white detail overprint. (RADIO ELECTRONICS).

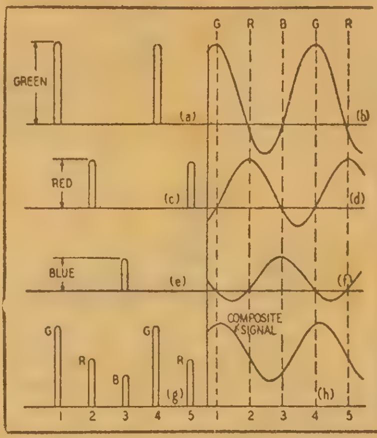


Figure 3: By passing a rapid sequence of color "samples" through a low pass filter and adding them, a composite signal (g-h) is produced, from which can still be extracted the original color values. The filter and sampling circuits represent the real secret — and the complexity—of the RCA system.

periods is so short that it produces a narrow d.c. pulse whose voltage represents the strength of that color at the exact spot being televised (Fig 3-a).

The electrical pulse representing each color sample goes to a low-pass filter. This filter broadens these sharp d.c. pulses into a displaced (Fig. 3-b) alternating current (a.c. with a d.c. component), which flows in one direction twice as long as in the other.

Thus the alternation whose peak voltage is the same as that of the pulse occupies two-thirds of the cycle. The filter cuts off all frequencies above 2 Mc.

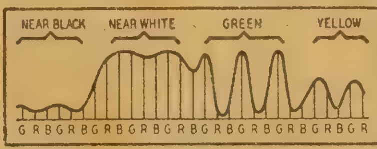


Figure 4: This diagram gives some idea of the ultimate video signal. Note how primary colors combine. Low intensity on all colors gives black, high intensity white. Note at right how green and red, without blue, combine to give yellow.

The three color samples in b, d, and f of Fig. 3 are combined in the composite wave of Fig. 3-h. This composite signal looks like a single sine wave from which retrieving the three color components would seem a hopeless task. But a look at b, d, and f reveals that, at the instant each color was is at its peak (the instant of sampling), the other two are passing through zero.

Neither red nor blue can affect the green signal at the green peak, so a sample of the composite wave, taken at that instant, gives the exact strength of the green signal.

The great advantage of the composite wave is that it can be of the same bandwidth as the sampling signal. Thus we get three 3.8-Mc. signals on a single 3.8-Mc. channel, instead of on one three times as wide.

In a 525-line picture, each color is sampled more than 7000 times per line. These samples are staggered so that when the alternate line is scanned, the sample of each color is taken midway between the samples of that color on the line above.

DETAIL MODULATION

To this composite wave is added the fine-detail modulation between 2 and 4 Mc. The complete signal then goes through the low-pass (4-Mc.) filter and is applied to the modulator of a conventional v.h.f. or u.h.f transmitter.

Fig. 4 gives an approximate — though quantitatively inexact—picture of the video signal as it leaves that filter, and illustrates how a secondary color like yellow is made up of pulses from two primaries.

Fine-detail modulation from the mixed highs is also present but has been omitted because of the difficulty of representing it in a diagram.

The receiver is standard right up to the video detector. At that point a sampler synchronised with the one at the transmitter takes short samples of the composite signal at the instants of red, green, and blue peaks, passing each color to its own video amplifier.

Color is restored by using three kinescopes (or a composite tri-color tube), whose phosphors glow in the three primary colors.

The colored "dots" are actually

(Continued on Page 111)

AMPLIFIERS FOR TAPE RECORDING

PART TWO

Continuing on from last month, this present article examines further the subject of amplifier design and concludes with a practical circuit for tape recording and playback. Even if the circuit is not followed in detail, it will serve as an excellent guide for those who wish to adapt existing equipment.

by

P. D. Thomas

THE output of the playback head is low, at about the same level as that of a high-quality moving coil or velocity mike. A voltage gain of at least 10,000 (80 db.) will be required, followed by power amplification appropriate to the conditions under which the recorder will be used.

For ordinary purposes two 6SJ7 stages followed by a 6V6 will give sufficient output. Design and layout follow normal high-gain amplifier practice; the usual precautions must be taken to avoid hum pickup and feedback.

It should not normally be necessary to heat the first stage filament with DC but, in high fidelity equipment, this may be desirable.

INPUT GRID

The grid circuit of the first stage depends upon the head impedance.

With a high impedance head directly coupled to the grid, the input voltage will be proportional to the number of turns on the head winding; however, there is obviously a limit to the number of turns which can be wound on a small core, even using the finest gauge of wire available. The optimum number of turns will correspond to an impedance of about 2000 to 5000 ohms.

The lead from head to grid should be as short as possible, and screened.

In the case of a low-impedance head a step-up transformer will be required. This should be mounted close to the grid of the first stage to keep the secondary leads short.

The line from head to transformer, being low-impedance, can be as long as necessary within reason provided it is screened, and so the first stage or two can be placed in the most favorable spot irrespective of the distance from the head.

This may be an important factor in deciding head impedance.

The transformer itself must be carefully screened, preferably with Mumetal. The obvious choice for this component is a mic transformer, which is designed to operate under the same conditions of signal level, &c., and will fit into the circuit perfectly.

The highest available ratio should be chosen unless the head has a "medium" impedance—100 to 500 ohms—in which case a ratio of between 20:1 and 40:1 would be used.

The ratio of voltage induced by the tape to voltage induced by stray fields is unaffected by the number of turns on the head. If there are less turns than the maximum possible, there will be more amplification, or a higher transformer ratio, to give the same output, and the hum level will be raised by the same amount as the signal.

The best way to keep the hum to a tolerable level is to reduce the intensity of the hum field around the head. What is left after this has been done can be eliminated by screening the head.

In theory the problem would be solved either by completely screening the head, or by removing it from the vicinity of transformers and motors which radiate AC fields. In practice neither of these is possible.

The tape must have access to the core of the head, so screening cannot be complete, and unless the capstan is driven by steam power, or clockwork, or by a shaft several feet long, the head must be within a foot or two of an electric motor.

However the situation is far from hopeless, as a very good compromise can be achieved with a little effort and time devoted to experimenting. The first step is to "map" the fields around the motors, &c., in the area wherein the head is to be mounted, to find the point where the hum is lowest, or at least at a reasonable level.

If only one motor is to be considered, this will be simply a matter of distance from the field winding in any given direction. In a compact layout there may be two motors and a power transformer to contribute to the field pattern.

TRACING HUM

The experiment may be conducted with an unscreened head connected to the playback amplifier, with the gain at maximum.

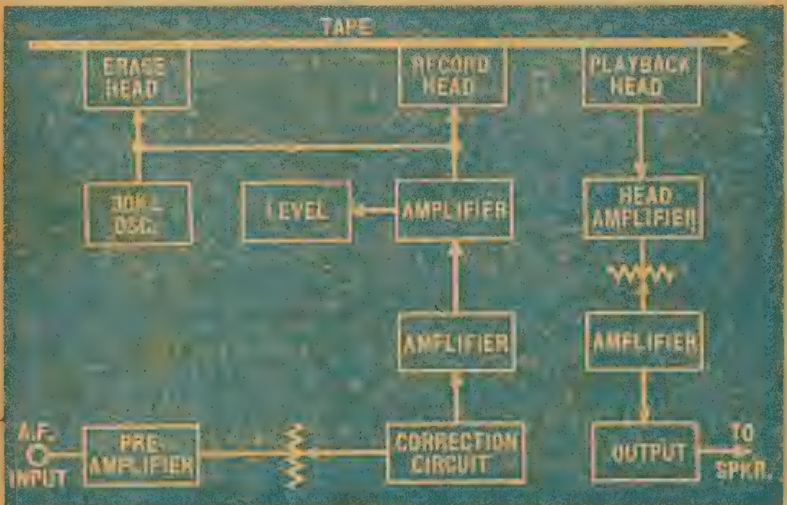
If the relevant motors, in their proposed positions, are switched on, and the head moved about the baseboard, it will be found that the hum pickup is quite strong in some positions, and weak or almost non-existent in others.

It may be found, too, that the field of one motor tends to cancel out that from another in certain spots. However too much reliance should not be placed upon this effect, as the field of a motor fluctuates with a varying load.

In any given position of the head, the hum induced by the power transformer can be minimised by rotating the transformer, and this should be checked frequently.

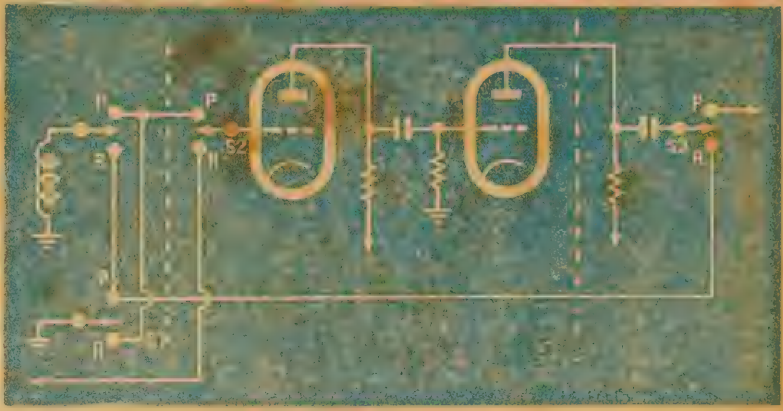
If a sheet of paper is fastened to the baseboard and an output meter connected to the amplifier, the actual readings can be plotted for any given arrangement of motors, &c. Two or three charts made in this way, one for each likely arrangement, are a great help in deciding on the final

(Continued on Page 59)



This block diagram shows the arrangement preferred by the writer, involving separate erase, record and playback heads with independent amplifier systems. With such an arrangement the recording can be monitored as it is being made, with only a fraction of a second's time delay.

TAKE CARE WITH SWITCH WIRING



A typical switching circuit, which changes the function of two amplifier valves. Note how an auxiliary switch S1 earths the line not being fed with signal to prevent capacitive leakage.

baseboard layout, as the minimum hum areas can be seen at a glance.

When the layout has been decided upon, the hum level can be checked with the head screened. If it is satisfactory, the design may be passed as OK.

The rewind motor is not taken into account when considering hum fields, since it is not used during the forward run.

In some professional recorders a large screening box is used to enclose completely the heads, which may also be screened individually, and portion of the tape, which enters and leaves through slits in each end of the box.

This is extremely effective since not only the windings and cores, but also the gaps and the tape itself, are shielded from all external fields; but it is rather more complicated mechanically, as the box must have a hinged lid to allow the tape to be threaded, or otherwise be removable.

If some degree of tone control is desirable in the playback amplifier, this can take the form of a top boost control; or alternatively, a combination of top boost and top cut.

TONE CONTROL

The majority of commercial recorders have a simple top cut control, but the value of this is debatable. There is no "Needle Scratch" to eliminate, as with disc recording, and the problem at low speeds is to obtain sufficient treble response, not to suppress it.

Experiments may call for a bass control, but in a finished design there is no need for this to be variable except for special applications.

As in the case of the recording amplifier, the power supply requirements are straightforward, and the same remarks apply. It is preferable to centre-tap the heater supply, and to connect the centre tap, not to earth, but to a point a few volts positive to earth; for instance, to the cathode of a 6V6. This considerably reduces the hum in the first stage.

If a separate head is used for playback, overall monitoring of the recording becomes possible, by listening to the output of the playback head while the material is being recorded.

Although this requires entirely separate channels for playback and recording, it is far more satisfactory than any other method of monitoring. For research and serious experimental work it is essential, since it is only by this means that the effect of changes in the bias circuits, &c., can be observed almost instantaneously.

The time lag is equal to the time taken by the tape to travel from one head to the other, usually about half a second.

CROSS-TALK

Fig. 8 is a block diagram of a recorder of this type. The tape passes the heads in this order: erase; record; playback.

The playback head must be very carefully screened from the others to avoid direct pickup.

With such a high overall gain it will probably be found that some stray coupling takes place between the amplifiers, which will cause a "background" on the playback channel of the material being recorded, unless they are built on separate chassis or carefully screened and isolated.

Having considered the essential requirements of both record and playback circuits, we now come to the problems of combining these in a complete recorder, and arranging switching to change from one function to the other.

Where separate channels and heads are used, "record-playback" switching is merely a matter of cutting the power supplies to the record amplifier, bias, and erase circuits, and a single-pole on/off switch is sufficient for the purpose.

In most designs, however, one head does double duty, and at least one stage is used for both recording and playing back—usually the first voltage amplifier, a 6SJ7 or equivalent.

This is for reasons of economy, since it is pointless to have two identical valves and associated circuits and only use one at a time, when by a simple arrangement of switching one stage can serve a dual purpose.

MONITOR AMPLIFIER

The last one or two stages of the playback amplifier may be used as a monitor amplifier when recording, in which case the playback volume control must be included in this section. An outlet for headphone monitoring will automatically double as an outlet to external amplifier, if this is needed.

When switching is carried out at several points in a circuit, which may be at widely different audio levels, such points must be kept well apart to avoid feedback, either positive or negative.

WATCH FOR ARGUMENTS

THE first of Mr. Thomas' articles has provoked a lengthy reply from another reader interested in tape recording amplifiers. Mr. Thomas, in turn, is quite happy to support his statements. Maybe other readers have their own special ideas. In short, you can expect some lively discussion in next month's issue.

The easiest way to do this is to use wafer switches with two or more sections, and keep the sections well apart, screening them if necessary. One section is then allocated to the head, another to low-level switching, another to output stages, and so on.

Where the circuit calls for a lead to run from one section to another, as in Fig. 9, an auxiliary set of contacts should be wired so as to earth this lead in the position in which it is not used. In the diagram, S1 earths the lead in the "playback" position.

The lead which connects the head to S2 and the first grid could also cause trouble, since on "record" there is a large difference in level between head and grid. So when the circuit is switched to "record" this lead must be earthed, also by S1 as this happens to be convenient. It is immaterial which end of such a lead is earthed.

The HT lead to the bias and erase oscillator will have to be broken in the "playback" position, but anode supplies to any other unused stages need not be broken unless it is desirable to reduce power consumption or for any other special reason.

When the bias current is cut abruptly, there is a danger that an appreciable residual magnetism will be left in the core. Although not sufficient to affect the tape directly, this will cause an excessive increase in the noise level on playback.

SWITCHING

To overcome this it is a common practice to provide the bias oscillator with a separate electrolytic of, say, 8 mfd in parallel with its HT supply, and to switch the bias on and off by breaking the HT line ahead of this capacitor.

When the circuit is broken, the discharging capacitor causes the anode voltage to drop relatively slowly, so that the oscillations decay slowly instead of being broken off, perhaps, on the peak of a half cycle. This gradual decay of the bias current effectively demagnetises the core of the head, ensuring a low noise level on playback.

It is possible to combine the motor and amplifier switching in one multi-position, or push-button, unit, but unless this is carefully planned it is

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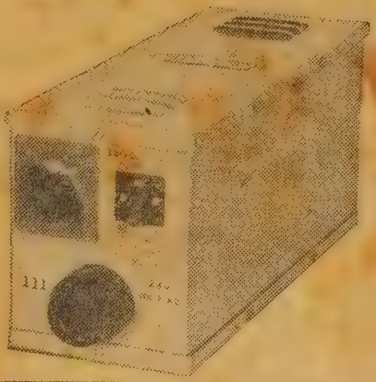

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likely to cause hum troubles, and in any case it is a less flexible arrangement. Therefore it is recommended that motor and amplifier switching be kept separate.

Fig. 10 is a circuit incorporating many of the points discussed so far. It is intended to illustrate how the record and playback channels can be combined in a single composite circuit. Therefore, although the component values given are correct, and the choice of valve for each stage is typical, the circuit might need some modification in practice to suit the heads, microphone, switch unit, oscillator coil, &c., to be used.

The power supply is not shown in Fig. 10, since it is quite conventional. It should be capable of delivering about 120 ma at 250-300 volts, and 3 amps for the heaters.

COUPLING EFFECTS

The record-playback head has a low impedance winding, which calls for input and output transformers for playback and recording respectively. The input transformer, T1, can be a good mic transformer, well shielded, to match from about 50 ohms to grid.

The erase head, on the other hand, has a high impedance; not because this is necessarily preferable to a low impedance, but to show how it is coupled to its supply of supersonic current.

Record-playback switching is accomplished by a seven-pole, two-position switch, the sections of which are numbered S1 to S7. To avoid instability, the switches can conveniently be mounted in three wafers, with S1 and S2 on the first wafer, S3, S4 and S5 on the second, and S6 and S7 on the third. There should be a screen at least between the first and second wafers, unless they are spaced by several inches.

The proximity of S3 and S4, and of adjacent contacts of S6, tends to give a small degree of coupling over their associated stages; which would cause negative feedback in the case of V4, and either positive or negative feedback, depending upon the relative phase of the transformer windings, in the case of V1. However, the amount of feedback will be so small as to be negligible if the wiring is carefully arranged.

If the grid circuit of V1 were of high impedance, there would be a certain definite amount of feedback, causing loss of high frequencies, due to capacitive coupling between S3 and S4 if these were very close together; normally, however, it is unlikely that this would be as much as that due to stray capacitances.

SCREENING

S7, being at AF earth potential, may be in any convenient position. It is very unlikely to cause trouble even if it is adjacent to low-level points such as S1 or S3. S2 is important; on "record" there is a difference of some 60 [illegible] 90 db between S1 and S3, and though these are low-impedance circuits, even the smallest coupling here cannot be tolerated.

The leads to the microphone transformer and that from S3 to the mic input socket must be completely screened if they are longer than an

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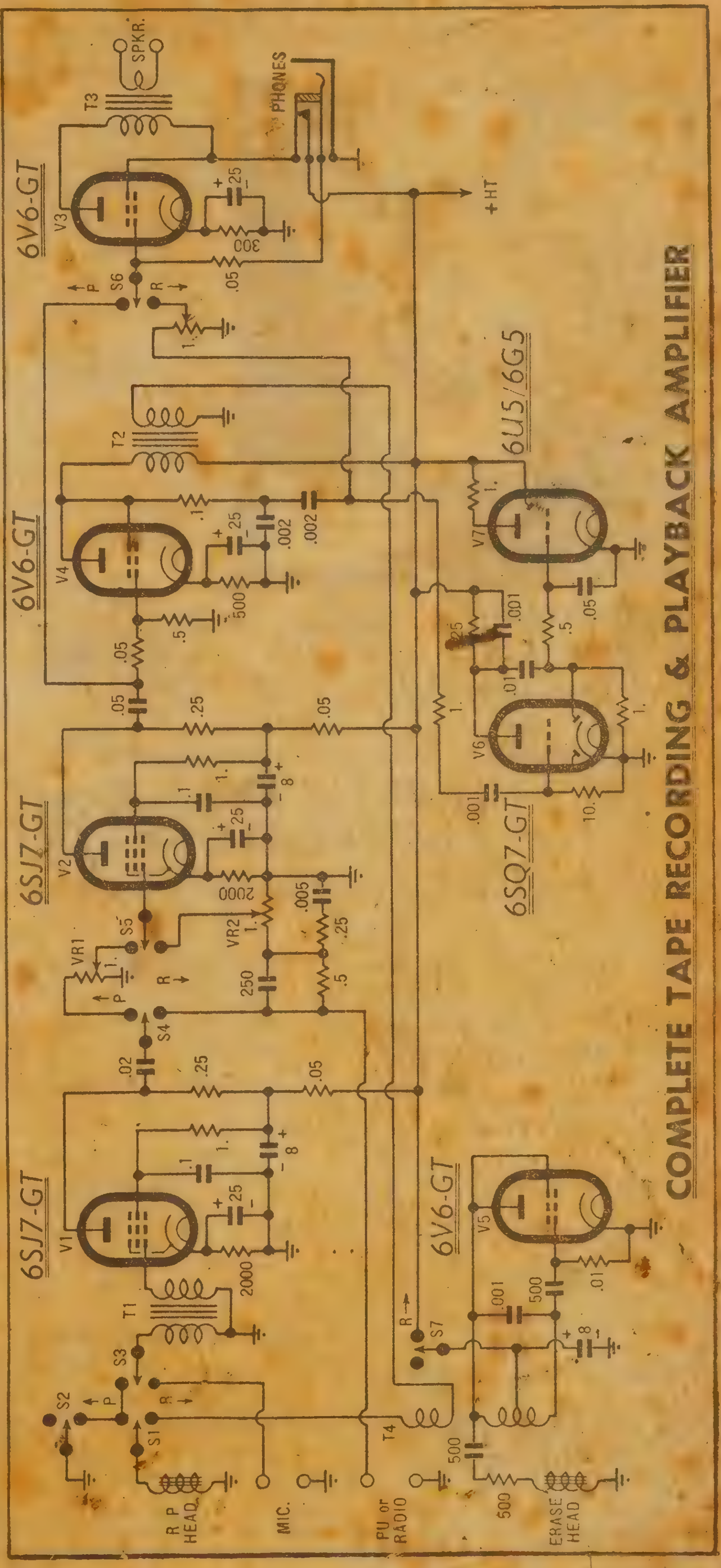
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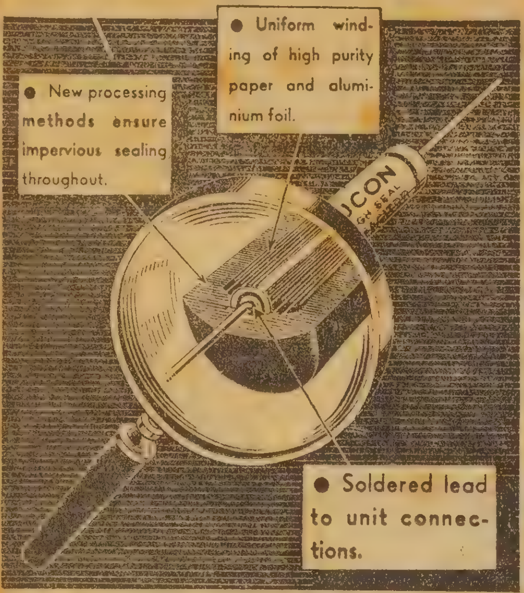
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inch or two, and likewise the lead from the head to S1.

The amount of screening required on the other leads depends on their length and the general layout, but unless the chassis is very compact there is nothing abnormally critical in the circuit except the bias and and erase sections, which must, obviously, be screened from the other stages.

It might be advantageous to mount V4 and V5 on a separate chassis or sub-chassis, with their associated circuits, including T2 and T4.

Apart from the record-playback switch the panel controls are: VR1, playback volume; VR2, recording level; and VR3, monitor volume. For the sake of economy, VR1 and VR2 could be replaced by a single control. This would be placed directly in the grid circuit of V2, with S5 immediately ahead of it, and would thus operate as a level control on both record and playback. However, this arrangement requires that the control be reset every time the operator switches from record to playback and vice versa, which may be undesirable.

PICKUP INPUT

The two channels which compose Fig. 10 will now be traced separately. First, assume that the R/P switch is in the "record" position, i.e., downward in the diagram.

The output of a low-impedance moving coil mic is fed through its input socket and S3 to the primary of the mic transformer T1. The secondary of T1 is connected to the grid of V1, a 6SJ7 pentode.

Cathode, screen, anode, and coupling resistors and capacitors all have their normal values appropriate to such a resistance-coupled amplifier. The anode and screen supplies are decoupled by a 50k resistor and an 8 mfd electrolytic.

The high-level input now joins the circuit. This comes from a radio or pickup, and is therefore at a higher level than the mic output, needing less amplification. It is presumed that only one input will be used at a time, so no provision has been made for fading.

The frequency correction network is made up by two resistors, of .5 and .25 meg, and two capacitors, of .005 mfd and 250 pf.

VR2 is the gain control, which is adjusted to the correct recording level with each input. This feeds to the grid of V2 through S5; V2 being another 6SJ7 stage identical with the first.

FEED TO HEAD

From the anode load of V2 the AF voltage is fed by the .05 mfd capacitor to the grid of V4, a triode-connected 6V6. This is less critical as to loading than tetrode operation. Actually a 6C5 or 6J5 or even a triode-connected 6SJ7, would provide sufficient output.

The coupling transformer T2 has to match the head to the required load impedance. A triode-connected 6V6 calls for a load of about 5000 omhs, so a ratio of 20:1 might be typical.

A speaker transformer, with its secondary wound for a voice coil impedance of about 3 ohms, giving a ratio of about 40:1, is not suitable unless the secondary is rewound with two or three times the original number of turns; but this is usually easy enough. A wire gauge of about 28 swg is satisfactory.

The AF output is fed to the head in series with the low-impedance winding on the oscillator coil, T4. The erase head is fed from the anode end of the tuned winding, through a 500 pf blocking capacitor in series with a 500 ohm resistor. The latter is intended to damp the resonance of the head with the capacitor, and may be unnecessary with some heads, but its inclusion does no harm.

The oscillator uses a Hartley circuit, with a triode-connected 6V6. A better waveform may be obtained in some cases by connecting the .001 mfd. tuning capacitor from the anode to the centre tap, instead of from the anode end to the grid end of the tuned winding.

As the final anode is transformer-coupled to the head, the volume level indicator and monitor amplifier are fed from the anode of this stage (V4). The decorrection network filters out any bias voltage which finds its way back through T2.

From this network, consisting of a .1 meg. resistor and two .002 mfd. capacitors, the 6V6 monitor amplifier is fed through a volume control, VR3; and the phone jack, from which audio can be fed to a larger amplifier, is connected across the grid of V3. A pair of auxiliary contacts on this jack breaks the anode supply of V3 to mute the speaker when using this outlet.

The output transformer and speaker are normal, chosen, of course, to match the 6V6.

The level indicator, a 6U5, is driven by a 6SQ7 as a voltage amplifier (V6), the output of which is rectified by one of the 6SQ7 diodes, connected so that a negative voltage is fed to the grid of the 6U5. The .5 meg. resistor and .05 mfd. capacitor smooth out rapid fluctuations of the AF waveform "envelope."

If the 6U5 shadow closes before the maximum recording level is reached, the input to V6 must be reduced. The most convenient way to do this is to connect a resistor of appropriate value, say, .25 meg., from the junction of the .001 mfd. capacitor and the 1 meg. series resistor, to earth.

FINAL POINTS

Alternatively, a 1 meg. potentiometer can be inserted at this point, connected as a gain control in the usual way; if this is mounted on the chassis it can be adjusted to give optimum sensitivity and then left alone.

It is possible to feed the 6U5 grid with AF without rectification, but the shadow is less clear-cut and accurate control of level is very difficult.

With the R/P switch in the "playback" position, the anode supply to V5 is cut by S7. If the anode supply to V4 were cut, it would be necessary to break its grid circuit also; otherwise the grid, acting as a diode, would shunt the AF line, causing serious distortion.

Now the head is connected to the primary of T1 through S1 and S3, and the voltage induced in the head by the tape is stepped up by T1 and applied to the grid of V1. The amplified voltage across the anode load is passed by S4 to the volume control, and by S5 to the grid of V2. Here the level is raised another 40 db or so, and the voltage developed across V2 anode is passed by the .05 mfd. coupling capacitor through S6 to the grid of V3.

The output can be taken from this point by the phone jack to feed an external amplifier, or amplified by V3 to drive the internal speaker.

(Continued on next page)

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WHAT ARE THE STARS MADE OF?

(Continued from Page 15)

and find that the light from it is stronger in the blue than in the yellow. Then we measure a cooler star and we find it stronger in the yellow than in the blue. We can go on measuring and comparing until we have built up a scale which can be used to measure stellar temperatures by the strength of the various colors as measured by a photo tube. A further example of the aid to astronomy by means of delicate instruments is the latest information gained about the planet Mars by means of infra red photography.

The study of the planet Mars has always been attended with great interest because of its supposed similarity to our own planet and the peculiar markings on its surface which seem to indicate some human effort in irrigating the planet by means of canals.

Most of the deductions were based on pure observation direct through telescopes and the spectograph until in 1948, when Dr. Kuiper, of Texas, devised an infra red spectrograph through which he could analyse the infra red rays reflected from the planet.

INTERESTING RESULTS

The energy which passed through this spectrograph was focused on to a small lead sulphide electronic tube, which acted like a trigger for any electrical energy actuated by infra red rays. The resulting records were irregular lines on graph paper. Knowledge of how to analyse these lines revealed the following:—

The polar caps of the planet do not consist of frozen carbon dioxide, as previously suggested, because they gave the characteristic reflection spectrum of ordinary snow.

This being the case, there must be water vapor in the atmosphere and therefore the whitish clouds seen at times must be water vapor clouds.

Infra red spectrographic data of the greenish portions of the planet gave results similar to the spectra of lichens and mosses found in the high altitudes of the Rocky Mountains and the Himalayas. There are no signs of seed plants or ferns.

The haze which always envelops the planet is apparently a layer of ice crystals and it is certain that from the planet itself the sky would appear white, instead of blue.

So the science of astronomy marches on with ever-increasing vigor, as new devices come to its assistance. Some of these devices have confirmed conceptions previously based on observation and logic. Others have disproved some previously-held ideas.

TAPE RECORDING

(Continued from previous page)

No tone control has been shown in Fig. 10, apart from the fixed correction and decorrection networks, since the constants of these circuits are assumed to be adjusted to give an optimum, reasonably level frequency response. However, if a manual tone control is needed, it may be inserted in series or parallel, according to type, with VR1, between S4 and S5, where it will only be effective in the "playback" position of the switch.

Let's Buy An Argument

by W. N. Williams

Phew! That was close but I'm still occupying the editorial chair. My two typing fingers are numb from the mere anticipation of punching linotype keys. Fortunately, sufficient people have agreed with my point of view to suggest that it isn't altogether arrant nonsense. Some have even put it in writing!

JOKES aside, it's a bad thing to get upset about a spot of criticism. Offered in the right spirit, criticism can be very helpful. It keeps you on your toes, prevents you from developing narrow, self-centred ideas. (After you've cooled down, I mean.)

Looking ahead, I can see some criticism and argument brewing right now in the matter of tape recording and the relevant amplifier designs.

Our current contributor (Mr. P. D. Thomas) will most likely be in the firing line to begin with, because one reader has already sent in a piece-by-piece dissection of Mr. Thomas' article in the last issue. But it's done in the right spirit.

Says this reader:

"*I would welcome a reply from Mr. Thomas or perhaps a discussion could be arranged. I would also very much appreciate a criticism of my own circuits as I am very anxious to learn better methods.*"

In an interview, the same correspondent put it this way to me. Said he:

"*Everyone simply tells me that my design is good. That might help one's ego but it doesn't assist me technically. No design is so good that it can't be improved upon in some respect.*"

Yes, we all have to take criticism, though it's sometimes based on rather shaky premises.

For example, I was "stood up" recently by a reader who'd apparently been brewing up some technical hard feelings for my special benefit.

Brandishing a particular issue he pointed an accusing finger at a passage which read something like this:

". . . . . the choke needs to be rated at 100 milliamps and should have a DC resistance of about 200 ohms."

I won't swear to the exact figures or the particular article, because it could be applied to dozens of designs.

"What's the use of statements like that?" quoth the said reader.

"Why don't you say what you mean instead of beating around the bush?

"If you don't know what the resistance should be, then who does? How do you expect us readers to make the sets work properly?

"Just what do you mean in this case? One hundred ohms? Three hundred ohms? Two-fifty ohms, or what?"

VALUE NOT CRITICAL

To all of which I could only reply that our vagueness was quite deliberate and that the DC resistance value wasn't at all critical. If it had been, we'd have said so. Any of the figures he'd volunteered would be quite satisfactory and, to all intents and purposes, the operation of the set would not be affected.

To prove that we could be specific when the occasion demanded, I turned up a paragraph relating to the Jubilee Portable. To quote:

"*The components specified for the AC supply must be duplicated exactly if the voltages are to work out according to plan. The choke used in original was a 14-henry 60-milliamp type, having a DC resistance of 300 ohms. Other brands of chokes might conceivably have a somewhat higher resistance than this which will tend to lower the operating voltages.*

"*The 300-ohm choke is to be preferred, because its lower DC resistance will avoid an undue heat rise under the full load conditions to which it is subjected. The original choke was a Ferguson C15/60 type, but any other choke with the same current, inductance and resistance ratings will do equally well.*

"*If you have to use a choke with higher resistance it will be necessary to decrease the value of R17, possibly to as low as 2000 ohms. The filament line should have about 8.0 applied when the mains are at 240 volts AC.*

In that particular design we were concerned about the fate of a whole string of filaments. Too much voltage would have meant their hasty demise; too little would render the set useless.

But that design and that set of circumstances was just one in a hundred. The filter system in an ordinary set isn't nearly so critical because plus or minus 10 volts on the HT supply doesn't mean a thing. In fact, very few multimeters can

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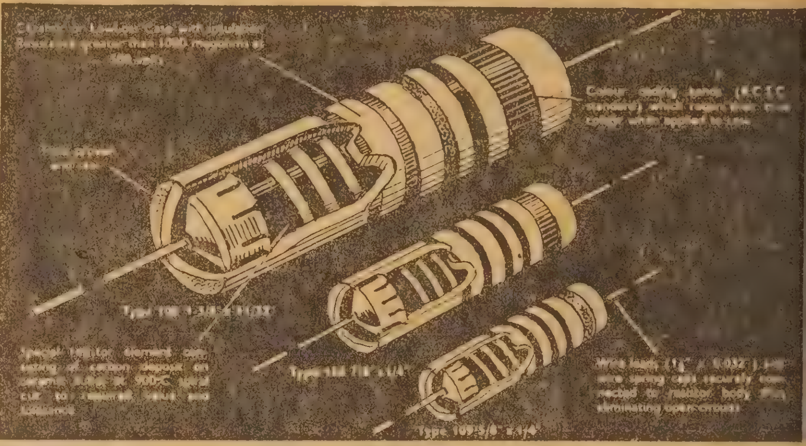

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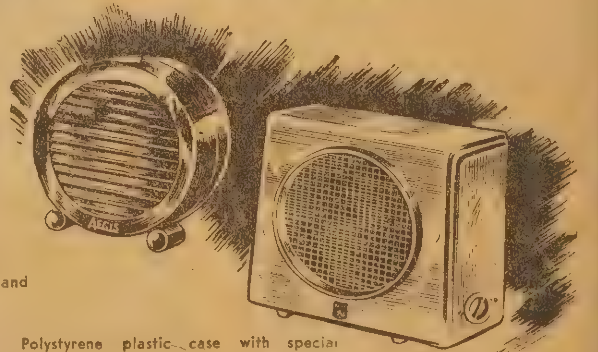

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read as accurately as that on the 250-volt range.

What would happen, in the ordinary set, if we were to specify a choke of so much inductance at so many milliamps and 187 ohms DC resistance. (It wouldn't be a neat 200 ohms, of course.)

First and foremost we'd have the trade houses driven mad by people demanding 187-ohm chokes. Once a definite figure is published, readers tend to demand it and nothing else will do.

Secondly, we'd have the manufacturers on the doorstep demanding to know why we didn't allow for their choke with a resistance of 212 ohms. It would do just as well, wouldn't it?

And, indeed, it would in nearly every case!

But why stop at the choke resistance when the resistance figures of the power transformer are just as significant in determining the ultimate voltage output?

LET'S BE REASONABLE

Imagine what would happen if we specified a transformer having a rating of so many volts, so many milliamps and ohmic values respectively for the primary winding, secondary winding and the leakage reactance! We'd really be in strife.

But don't get the idea that I'm going on from here to campaign for a slap-happy anything-will-do approach to set design. I've spent far too many years with slide-rules, tables and graphs for that. But we must be realistic.

Some components, as in the filament circuit already mentioned, in audio filter systems, in some kinds of instruments, superhet padder capacitors and such like, do have to be accurate for the device to work as intended. Very properly, such components should be specified and made available to the requisite tolerance, but that's as much as can be said.

If a manufacturer can hold his total production within a close tolerance, it's nice to know but it may not mean a thing in terms of final results from a given set.

Though I risk losing track of the original theme—criticism and all that—may I go on to stress that all normal radio components are manufactured and distributed to certain tolerance values.

TOLERANCE

No quarter-meg. resistor is ever exactly 250,000. Unless specially selected or rated, it will have a possible tolerance of 20 pc, which means that its actual value may lie anywhere between 200,000 and 300,000 ohms.

The same applies in principle to all components, though some lend themselves to closer control during manufacture than do others.

The tolerance idea is universal in industry and is essential for cheap mass - production methods. Just imagine how the cost of resistors would soar if the manufacturer had to reject whole batches which happened to be a few ohms out, because something went wrong with the carbon mix. And how futile, too, if the discrepancy meant nothing in practice.

Even valve manufacturers, who usually exhibit a passion for detail, have to allow for variations in circuit components, supply voltages and in their own products, too. Hence their use of "design centre" figures for applications where things are likely to get a bit "sticky."

As a matter of fact, their very curves, which are looked upon with such holy awe by the multitude, are often a masterpiece of legitimate (though equally definite) wangling. I know, because I've drawn some of them! Here's what happens:—

First you have to select from a batch a valve which exhibits as near as possible to the average and (we hope) the intended characteristics.

This is then set up in a test board with regulated supply voltages and a whole string of substandard meters. Plate, screen and grid voltages are varied in turn according to requirements and readings taken of the element currents.

The low current readings have to be taken first because high current readings may be sufficient to "age" and alter the valve's characteristics right in front of your eyes.

The first objective will certainly be a complete plate family of curves, then probably a grid family—if I can coin a phrase. For a pentode, different sets of curves may be needed for different screen voltages and, finally other curves showing actual dynamic operation.

Having done all this (and become "figure-happy" in the process) you end up with an enormous list of readings. Thereafter, you repair to the board and become a combined draughtsman and interpreter. One qualification without the other is generally quite useless.

So you draw, for example, the complete plate family and then proceed to examine them. Perchance one curve is obviously out of position because of a metering or a reading error. Maybe it can't be repeated satisfactorily, because the test valve has been affected by subsequent high current tests.

WHAT TO DO ?

What then is the right course? Should the curve be published with a known and obvious inaccuracy or should it be "doctored" to show figures that look right but were never actually obtained in practice?

Next the grid family of curves may be drawn and it is pretty certain that specific points on the grid family won't check exactly with equivalent points on the plate family. When this occurs the draughtsman must either ignore the error of proceed to reconcile it by applying a "correction factor" to one set of figures.

For those who like playing at curves, I picked at random the plate and grid family from American data on the 6J5.

DON'T BLAME ME!

Dear Sir,

It is hard to believe that the alleged existence of a "freak" x-tal pick-up is sufficient grounds for the replacement of a capable Technical Editor.

If this is so, inversely and by the same type of logic, a Technical Editor should be capable of quite passable audio reproduction in the role of a pick-up. (Plus minus 3DB. ???)

I am using 3 channel equipment, XP-046 G.E. reluctance, diamond stylus, cartridge in Grey 16in., arm on Rek-O-Kut 16in, 3 speed turntable — 3 Williamson amplifiers (KT66's, CFB Partridge trans.).

(1) 20-200cs, Audiom 70 in Klipsch.

(2) 200-2000cs, Axiom 22 in Reflex.

(3) 2000-20,000cs, Axiom 80 in Helmholtz.

With this equipment, intermodulation and other forms of distortion are at a very low figure. Microgroove reproduction is superb and makes it impossible, at the present time, for me to agree with any of the statements in Mr. K. I. Page's letter.

In spite of having a rather similar name.

Yours faithfully,
Kenneth A. Page.

MORE NONSENSE ?

That letter you received regarding the better performance of 78 records was obviously written by someone with little knowledge. I do not for one minute believe that nonsense about the response of their pickup being level to 23 Kc. There never has, and I don't think ever will be a crystal pickup with a level response between any freqency limits. They apparently do not know about bass boost in crystal pickups. I suggest that they tested it by running it on a frequency record to about 5 Kc and then speeding the turntable till it gave an equivalent frequency of 23 Kc. (R. T., Arncliffe, NSW.)

MORAL ASPECT

In your article "Let's Buy an Argument" the point was raised about deaf aids.

I am not an electrical or electronic engineer, but during our engineering education it was always emphasized that we had as intellectuals a great responsibility towards the world and the well being of the individual, and we should know and understand precisely where the limits of our field of action have to be drawn.

It is in the light of these principles and ideals that I am strongly of the opinion that popular design of deaf aids is a dangerous experiment and should not be encouraged.

Not so much because I do not trust the ability of the engineer who initially works out the design, but because the design comes in the hands of a large section of the population that just fiddles around with electronics and either do not care what results from their ill-advised efforts or because they cannot raise their mind to the ethical level of the real engineer.

When these people produce rubbishy receivers or amplifiers they can merely annoy their victims, but when making deaf aids they can do infinite harm.

These apparati should remain in the hands of nobody else but medical men qualified to give advice to patients.

I know that I have herewith expressed also the feelings you have on this matter, as I understand from the article.—(H.B. Broken Hill, NSW.)

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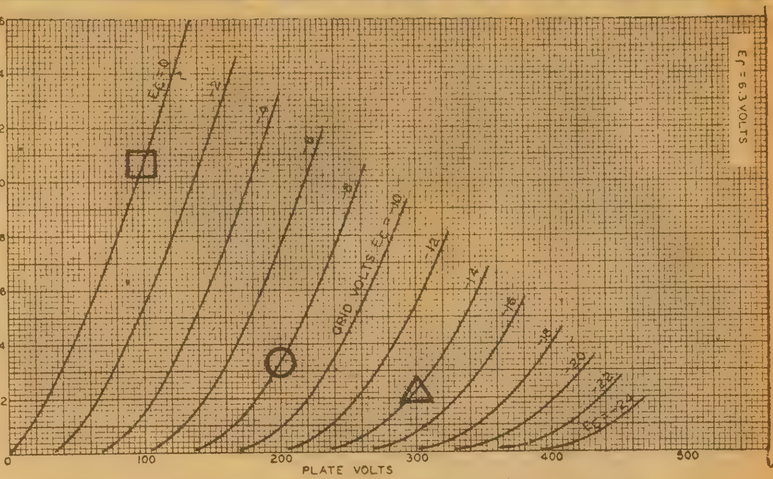


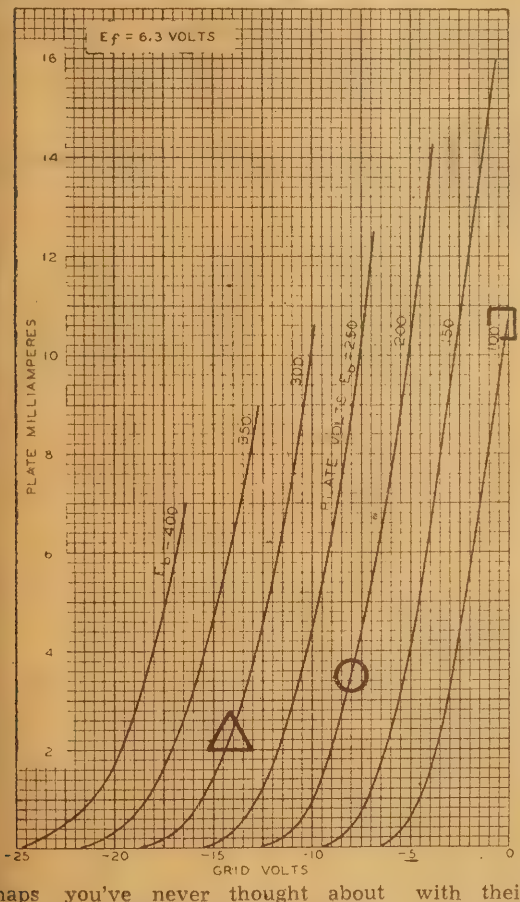
From the plate family, the current at 200 volts plate and -8.0 grid is 4.3 milliamps. The grid family says 4.5 milliamps for the same condition. Which figure should you believe, or should the draughtsman have corrected the error in the first by compromise?

If I haven't miscounted, there are 29 points of direct comparison between the two curves, without interpolation. Check them if you feel inclined.

With a pentode and its screen family, the number of check points grows alarmingly. Then, for good measure, it is possible to run the rule over the curves and estimate things like mu, Rp and Gm, to see how closely these check with published values.

It's bad enough fitting the curves to one another, let alone trying to fit production valves to the curves.

What am I driving at? Nothing in particular, except that it all arose from this talk of accuracy and tolerance. I chose to expand upon valve curves because they always look so final, so precise, so mechanical. Perhaps you've never thought about the human element behind their production.



To return again to the original theme of technical criticism, my "assailant" mentioned earlier also had a lot to say about output loads for power valves. Some of the figures we'd mentioned, didn't look right to him in the light of published data.

There's quite a story there, and rather than risk spoiling it, I'll put it aside for another day. It will keep.

We are still getting letters and phone calls about hearing aids. It's a subject that's certainly of widespread interest, but one with many angles, and I'm not too sure whether we should put the traditional English or the modern American interpretation to the word "angle."

Of all data published in the electronic field, valve curves &c are probably the most useful and respected. Despite this, they must be treated only as "approximate." Their accuracy is not absolute, but is subject to the same manipulation and tolerance as for other components. Cross-check any set of curves for accuracy. Three of many typical check points are shown, some accurate, others revealing an error.

AN OBJECTION

One point has been made, however, by a body which is vitally interested in the profession as a whole. They are apprehensive lest technical articles on the subject should prompt hearing aid users to "repair" or modify their own commercial units.

I couldn't agree more with their objection. The modern miniature hearing aid is a masterpiece of compactness and requires adequate knowledge and a steady hand of anyone prying among its innards. One should no more think of tackling one of these with pliers and a 60-watt iron than you would of repairing your watch with a hammer and a monkey wrench.

As a general policy, we never encourage the modification of even ordinary commercial receivers or amplifiers, let alone miniature equipment, replete with guarantees, &c.

If and when we do describe anything, it will be on the strict understanding that "it's worth trying." Buy the parts and build it if you want, but, if it doesn't suit you, well, use the parts for something else!

We'd be looking for all the trouble in the world if we were ever to produce an article which purported to show readers how to wreck and rebuild their hearing aid in one easy lesson. No sir!

Meanwhile, quite unsolicited, I came across a rather pathetic case which emphasised to me, if ever one did, the possible value of a true binaural aid. I repeat the circumstances for what they're worth. Maybe they're unusual, maybe not.

I met the particuar man many years ago, when he was first losing his sight. He became gradually and totally blind, but learned to rely heavily on his sense of hearing.

Now, however, his hearing has weakened to the point where he misses ordinary conversation unless it is directed specifically at him. A hearing aid has overcome the loss of gain very effectively, but, he complained . . . "I have no sense of direction. When someone speaks, I can never tell which way to turn my head and traffic noises terrify me . . ."

Pathetic, yes, but a fellow man. Would a binaural aid solve his problem or am I being sentimental rather than practical?

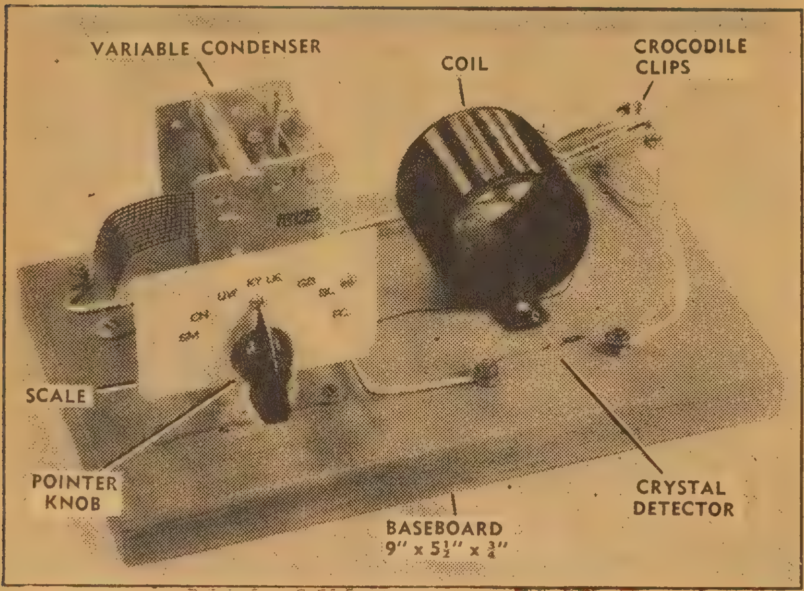
AN IMPORTANT POINT

There's one point about a binaural aid which might cause real difficulty

When we use our two ears to locate a sound source, the tendency is to turn the head toward it, after which it should be in front of the face. With a binaural aid attached to the body, however, the sound would not relate automatically to the position of the head. In fact, until such times as the body is brought around to face the source of sound, it might appear to be anywhere but in the right place.

I know that some work has been done along these lines, although none of the correspondents thus far has mentioned it. If memory serves me correctly, the RCA Labs. built an exact replica of the human head and aural system for binaural experiments.

Life's too short. There's so many interesting things to try out and read about!



The card for the dial scale is held in place with two long bolts. The exact position of the stations can be found when you have the set operating.

Teach Yourself Radio (2)

IT CANNOT HELP BUT WORK!

This month we translate the ideas discussed last month into a practical radio set. The wiring is very simple and with the aid of the diagrams, anyone can build the set without the slightest possibility of making a mistake. Even some of the well seasoned members of Radio and Hobbies staff got quite a kick out of this little set. Try it for yourself.

by Maurice Findlay

BEFORE we went into the laboratory to make the set we did quite a bit of thinking, not only about the set itself, but about the type of chap who is likely to build it. Probably he is a young chap still going to school. Hard cash for parts is not easy to come by, so that it is no use suggesting elaborate cabinets, dials, &c.

Of course, it is just as bad to go toward the other extreme. Most people take pride in their workmanship and, even if the finished set did work, they would not get as much fun from a messy job as they would from a neat and tidy set.

NO SOLDERING

But it must be kept in mind that many, many young chaps have not yet had a try at soldering and, furthermore, do not have the money to buy the special fixing devices which are used in large sets to hold the wires and the various other parts in place. Nor can we be sure that all our younger readers will have more than a screwdriver, a pair of pliers and a few other simple tools.

With this in mind we set to work and produced the crystal set shown in the photographs. For us, it was a temptation to pick up a soldering iron and solder some of the joints, but we resisted with, of course, no difference in the performance of the set.

We are certainly not making an argument for not soldering joints in large receivers, but rather proving that it is possible to make a simple receiver such as this, even if a soldering iron is not available.

Wood is an excellent insulator and can be cut to size easily, so that we made the set on a block of wood, terminals and joints being made with ordinary 1-8in nuts and bolts, tightened in holes in the wood. In our case the wood was an ordinary piece of pine 9in x 5½in x ¾in.

The size isn't very important. The main thing is to be able to fit all the parts in the space, so that, if you have a smaller piece of wood, try fitting all the parts roughly before you attempt to screw them in place. By the way, in this particular set it does not matter where the various parts are placed in relation to each other, with the possible exception that it would not be a good idea to mount the coil hard against the tuning condenser.

If you have a wood plane, you can plane the board smooth and square and then give it a rub with sandpaper. If you like, you can add a coat of lacquer, so that the wood will not be soiled with handling.

SOURCE OF PARTS

In addition to the baseboard, you will probably be able to find the nuts, bolts, washers, wood screws and the piece of card for the scale among your stock of scraps. If you can't find the exact sizes mentioned you may be able to find something that will serve equally well.

The condenser, crystal and some of the other parts shown in the photograph can be ordered from any radio store. They aren't very expensive, but if you already have a few parts you may like to use some of them. It is with this in mind that we prepared the pictures on page 75.

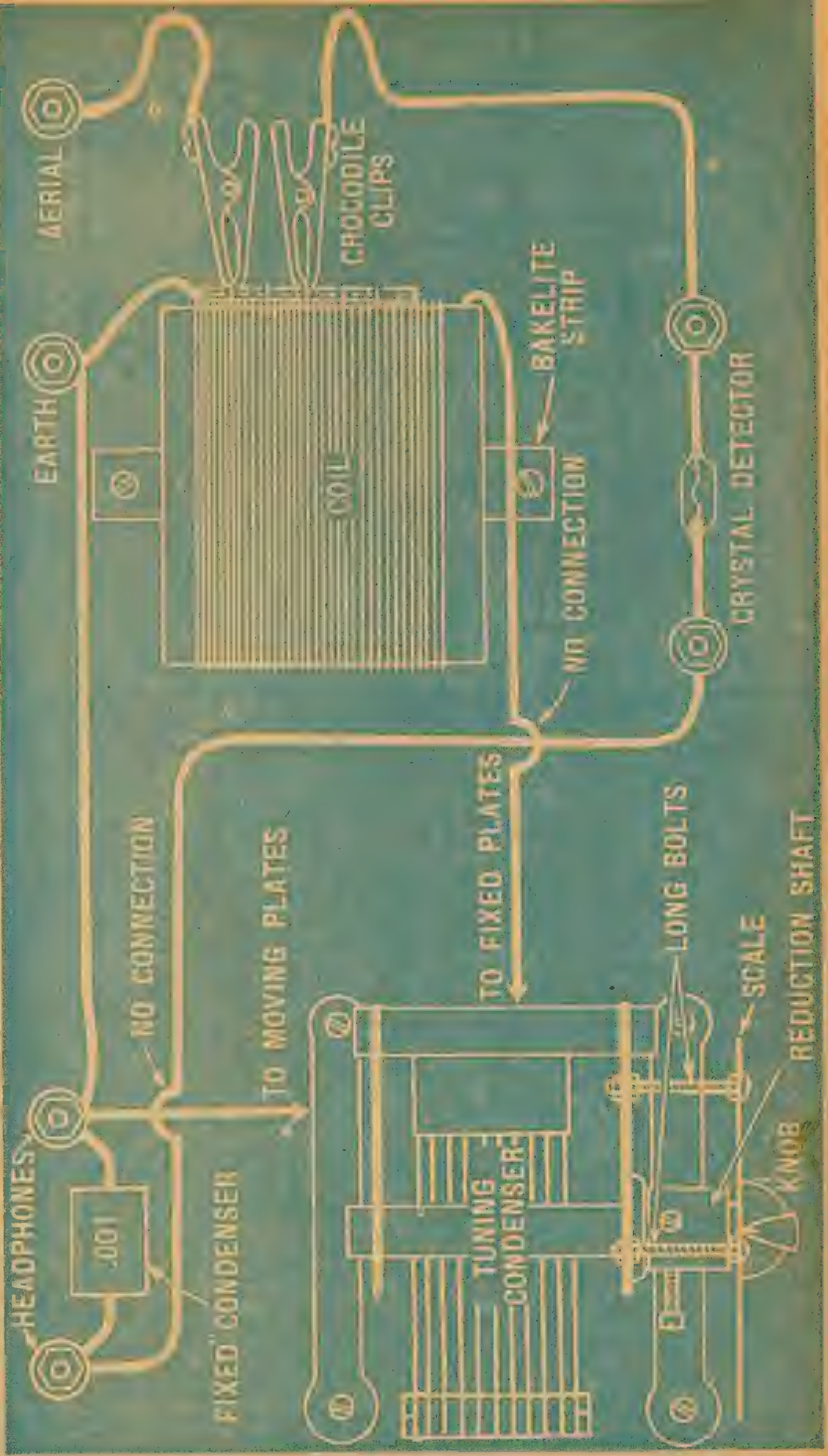
Take the crystal detectors, for example. There are several different types which could be used.

Nowadays, we favor fixed crystal detectors, such as the GEX33 or the GEX44. Not only have they the advantage that they do not require any adjustment, but in most cases the signals are louder than from the adjustable types.

They are very reliable in their adjustment and will stand a fair amount of shock and vibration. As a matter of fact, we accidentally dropped one off the bench, with apparently no ill effects. We don't recommend such treatment.

The GEX33 consists of a tiny glass envelope (it is only about ¼in long), with a wire coming out of either end. A very small piece of germanium crystal is held inside one end of the envelope and connected to one of the wires, while a very fine piece of wire (often called a catswhisker) is connected to the other main wire. The other end of the fine wire touches the surface of the crystal. The position is adjusted

The overall size of this drawing is just a little smaller than the size suggested for the wooden baseboard. However, all parts are shown full size and in their correct relative positions so that, if you wish, you can cut it out and paste it on the board as a guide to the wiring.



for best results at the factory, and no further adjustment is possible or necessary.

Of course, if you already have an adjustable crystal and do not wish to spend money on a new one, by all means go ahead and use it. It is almost certain that it will take more room than the fixed crystal, but there is plenty of room on the baseboard. We left the space for the crystal on the right-hand side of the board, so that you can use your right hand for the adjustment.

VARIABLE CONDENSER

Variable condensers are very likely to be found in boxes of junk parts. They come in so many shapes and physical sizes that it is almost impossible to give a complete list. The main thing is that it should have a maximum capacity of between .00035 and .0005 mfd (the microfarad is the unit used to measure the capacity of a condenser) and that there should be no electrical connection between the set of fixed plates and the set of moving plates.

If the plates are bent so that the opposite sets touch at any setting it will be necessary to straighten them. Sometimes this can be a tricky job, so that if you decide to renovate an old condenser, go about it very carefully.

REDUCTION SHAFT

Modern condensers such as the one used in our receiver have a 3-8in diameter shaft intended to fit the standard dials used in larger sets. It would be very silly to use an elaborate dial with a small set such as this, but all the available knobs have holes designed to take ¼in diameter shafts. The solution to the problem is to use a reduction shaft which itself has a ¼in diam. spindle, but which fits over the 3-8in shaft of the condenser. These are available in the usual radio shops for a small sum.

All the new condensers have a set of mounting feet provided, which allow them to be screwed to the baseboard. If you use one of the older types which does not have mounting feet, it may be necessary to make a special bracket. Incidentally, many of the older condensers have ¼in. diameter shafts so that the special reduction shaft is not necessary.

To make the coil you will need a coil former and a length of enamelled copper wire. The coil former is nothing more than a piece of tubing 2in. in diameter and 2in. long. The bakelite tubing sold especially for the purpose is ideal, but there is no objection to using cardboard if you can find a suitable piece of the correct dimensions. There is even a possibility that you could make quite a good coil former from some ordinary flat card by pasting it together.

In our case the coil was wound with No. 24 B. and S. enamelled wire. The wire could be a little thicker than 24, say No. 22 or No. 20, without any objectional change in the characteristics of the coil. It could also be a little thinner, the main objection being that the wire may break too easily when the crocodile clips are connected.

With 24 gauge wire the winding occupies exactly 1½in., so that you can make the holes for anchoring the ends of the wire before starting the winding. Make two holes at both ends and about ¼in. apart in each case, Anchor the end of the winding by threading the wire through one of the holes, up through the other, down through the first, and finally back up through the second one again.

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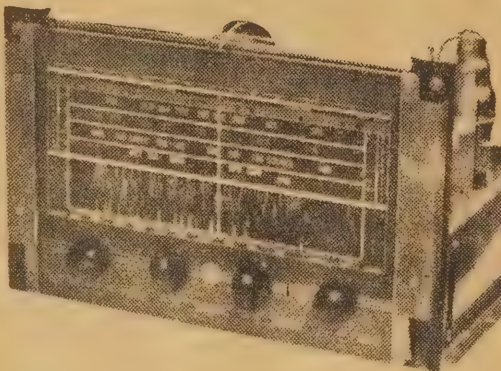

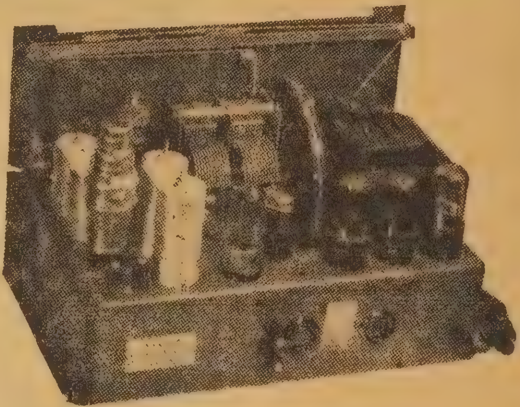

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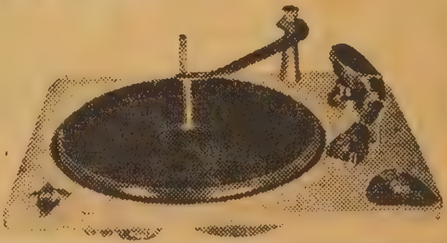

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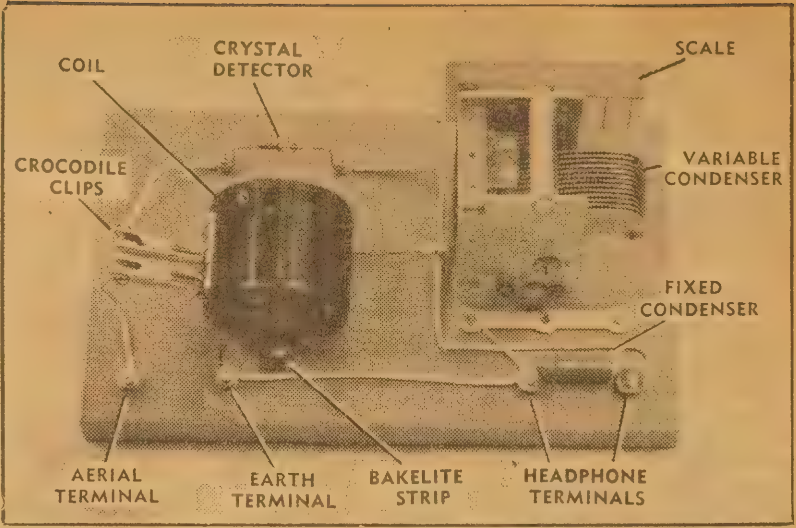


Some of the features not clearly visible in the photograph on page 70 can be seen in this photograph. When it was taken a fixed condenser of the mica type was installed.

Leave about 6in. of wire free so hat you can make the connections to the other parts of he set without having to make extra oints.

Wind nine turns of the No. 24 wire, n whichever direction you happen to nd easiest, making sure that each urn is pressed close to the previous ne. There will be no connection etween adjacent turns because the namel on the wire is an insulator or electric currents.

WINDING THE COIL

When you reach the tenth turn lace one end of a 1¼in. length of wooden matchstick under the wire. Then the eleventh, twelth turns, &c., re placed so as to pass under the matchstick leaving the tenth turn nly sticking out from the body of the winding.

Continue until you come to the wentieth turn, which is again wound ver the matchstick and similarly the hirtieth, fortieth and fiftieth turns. Finally, wind on a further fifteen urns to make up a total of sixty-ive turns. The winding will then be exactly 1½in. long (if you've used 24 gauge wire), and the end of the wire can be anchored in the holes already prepared.

Have everything prepared before you start to wind the coil, because here is nothing more annoying than o have the job almost finished and hen have to let the wire go in order o find something.

The next job is to push a second matchstick in alongside the first, under the five wires. This will not be oo hard if you cut a slight chamfer on the end of the matchstick with a penknife. Then push the two matchsticks about ½in. apart. If you carefully remove the enamel from the five wires going over the matchsticks, you will be able to make connection to the taps on the coil with crocodile clips.

The wire will stretch slightly when you push the matchsticks apart, but it is not likely to break unless you are very careless. In fact, there is the advantage that the extra tension helps to keep the coil nice and firm.

FIXED CONDENSER

As you will see from the schematic circuit and the layout drawing a fixed condenser is connected across the headphone terminals. This may be one of several different types.

These condensers have plates which are separated by an insulating material in something the same way as the variable condenser has plates separated by air as the insulating material.

However, the plates are usually very much thinner, and materials such as mica and paper are used for the insulating material. Because the value of capacity does not need to be varied, the condenser can be made very much smaller for a given capacity; the fixed condenser in this set has 2½ times the value of capacity of the variable condenser has plates a small fraction of the size.

Fixed condensers suitable for the crystal set are often made in the form of a tube and with paper insulation. These are very much cheaper than the mica insulated condensers, and will work just as well in this set.

There is no strong reason why the enamelled wire of the type used to wind the coil should not be used to make the electrical connections of the set if you do not have any special hook-up wire. Most of the hook-up wires nowadays consist of a number of strands of tin-coated copper wire covered by a layer of plastic or rubber. They are much more flexible than the solid conductors and therefore more suitable for the wires to the crocodile clips. Only about 18in of hook-up wire is required.

If you use enamelled wire always remove the enamel before attempting to make a connection. It may be scraped off with a knife or emery paper, the latter having the advantage that it is less likely to weaken the copper conductor.

In the case of plastic-insulated wire the insulation can be removed with an ordinary pocket-knife. Hold the wire between the knife and a finger and roll the wire against the knife just sufficiently hard to cut through the plastic without cutting the conductor. You will then find it quite easy to push the unwanted part of the plastic off the end of the wire.

Most of the connections in the set are made with the 1-8 inch bolts, washers and nuts. The idea is to make the hole in the baseboard with a countersink underneath so that the head of the bolt will not stick out and scratch your table. Pass the bolt up through the hole and twist the wire or wires around it. Then place a washer and a nut on the end of the bolt and tighten.

MAKING CONNECTIONS

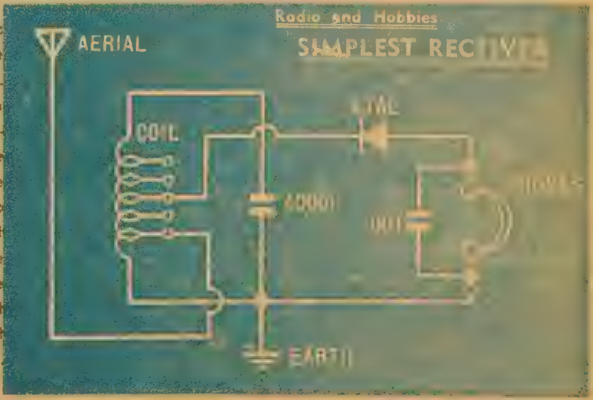
In the case of the aerial and earth and the headphone terminals, place another two washers and a nut over the end of the bolt. The aerial, earth wires, &c., can be gripped between the washers. This is a very much cheaper and almost as effective way of making the connections as the conventional spring-loaded terminals.

If you use one of the older type adjustable crystals it will probably be provided with its own terminals, but one of the modern fixed crystals can be supported between a pair of terminals made in the same way as those for the aerial, earth and headphones.

Most of the modern headphones are supplied with solid tip jack terminals and we found it easier to hold them under our home-made terminals if the uppermost of the washers holding them was bent in the middle.

The only connection in the set which must rely entirely on the

In the schematic circuit symbols are used for the parts. It is a good idea to get used to reading diagrams like this one because large sets are so complicated that it is almost impossible to draw all the parts. Compare it with the layout drawing on page 71



twisting technique is that between the coil and the fixed plates of the tuning condenser. Be careful to remove all the enamel from the wire and then twist it firmly around the wire from the condenser several times. The wire which makes connection to the fixed plates of the condenser can be secured under the mounting feet, where the wood screw holding the condenser to the baseboard will make sure that the wire is pressed firmly against the metal.

CONNECTING THE CONDENSER

Some of the older type condensers have thumbscrew terminals, in which case the method of making the connections will be obvious.

Headphones are a fairly expensive item if bought new and through the usual supply houses. Of course some of the latest headphones are very sensitive and, largely by reason of the reduction in weight, are more comfortable to wear than the older types.

If you can afford to buy a new pair by all means do so, but on the other hand sometimes an excellent pair of phones, or perhaps a single phone, can be bought for a few shillings. Before buying a secondhand pair of phones ask the dealer to check them for you, because the fine wire in the coils is sometimes damaged, rendering the headphones useless. If the magnets have deteriorated with age the phones will not have their full sensitivity.

Some of the headphones on sale at the present time are low resistance types and are not very suitable for crystal sets unless a special transformer is used.

PARTS LIST

Here is a list of the parts you need to make the crystal set. Read more about them in the article.

Wooden baseboard 9in x 5½in x ¾in.
Variable condenser (.0004 mfd aprox.)
Crystal detector (GEX33 etc.)
Fixed condenser (.001 mfd)
Headphones
2 Crocodile clips
Coil former (2in length of 2in diam.)
Bakelite strip 3in x ½in x 1/16in
Length of No 24 B & S enamelled wire
Pointer knob
Reduction shaft ⅜in to ¼in
8 ⅛in diam. bolts, 1in long
16 ⅛in nuts
20 ⅛in washers
6 small wood screws
Materials for aerial and earth (see text)

High resistance phones may have a resistance between, say, 4000 and 1000 ohms. Anything in this range would be quite suitable with perhaps a preference for the high resistance, assuming that the phones are of equivalent quality otherwise.

While a sensitive pair of low resistance phones will sometimes work when connected directly to a crystal set it is necessary to have a special matching transformer for best results. The transformer will have two leads connected to a high impedance winding and another two leads connected to a low impedance winding. Connect the high impedance winding to the terminals of the crystal set and the low impedance winding to the phones. If provided with a suitable transformer the low resistance phones will work just as well as the high resistance types.

Before you can start receiving signals, it is also necessary to have an aerial and earth system. This is of paramount importance in the case of a crystal set, because you are depending entirely on the energy picked up by the aerial to operate the diaphragm of the phones.

THE AERIAL

The aerial should be at least 30ft long and up to 100ft, if you live a long way away from the nearest radio station. About 15 miles airline is usually considered the limit for good reception with a crystal set, but where everything is favorable, it may be possible to extend the range a little.

The higher it is possible to make the aerial, the stronger the signals are likely to be. You will probably have to be governed by existing trees, chimneys or masts.

The aerial proper consists of a length of conducting wire. Copper is best and it should be thick enough to obviate the danger of it breaking under its own weight. However, if you do not have anything better, even ordinary fencing wire could be used. Many of the fancy aerial schemes in vogue some years ago have been proved to

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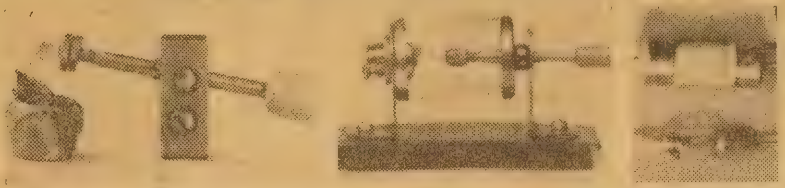
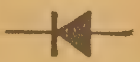
THIS IS HOW THEY APPEAR **SYMBOL**

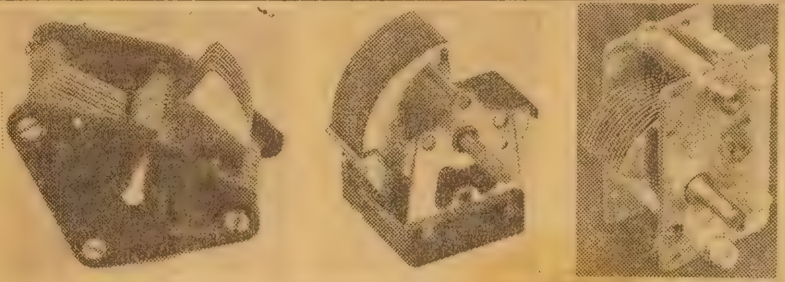
CRYSTAL DETECTORS

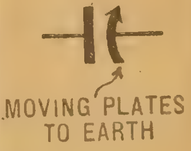




The crystal detector may be connected either way around. Fixed crystals are shown at the right.

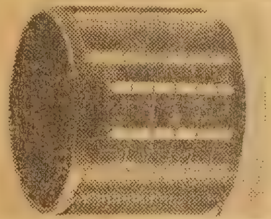
VARIABLE CONDENSERS




MOVING PLATES
TO EARTH

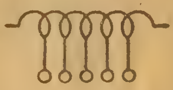
Make sure that the condenser has a sufficient capacity range to cover the broadcast band.

COIL



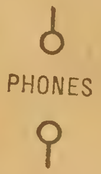
WINDING DATA

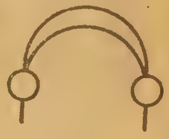
65 turns of No. 24 B & S wire close-wound on a 2 inch diameter cardboard or bakelite former. Taps are made at 10, 20, 30, 40 and 50 turns as described in the article.



A few drops of model aeroplane cement or clear nail laquer will help keep the turns of the coil in place.

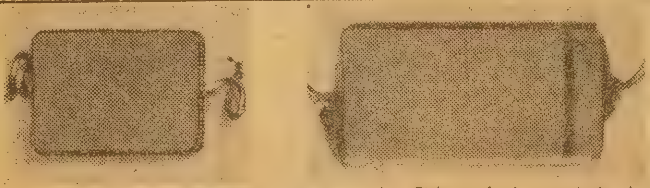
HEADPHONES

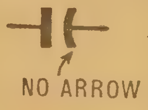


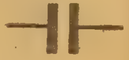


The headphones at the right are a low impedance type and require a matching transformer.

FIXED CONDENSER

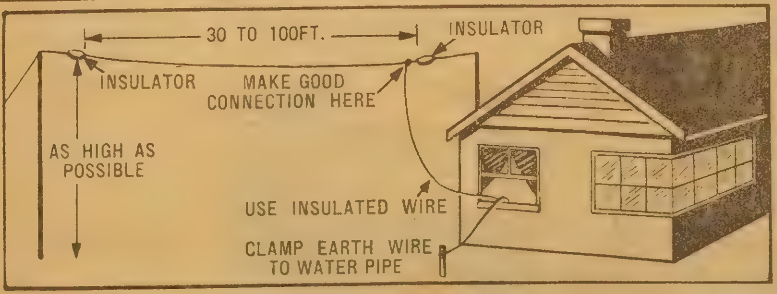


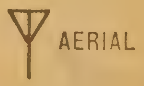


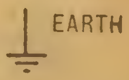


The paper condenser is at the right. Either of the symbols shown may be used for either type.

AERIAL AND EARTH


30 TO 100FT.
INSULATOR
INSULATOR
MAKE GOOD
CONNECTION HERE
AS HIGH AS
POSSIBLE
USE INSULATED WIRE
CLAMP EARTH WIRE
TO WATER PIPE





If no water pipe is already available drive a short length into the ground especially for the earth.

be of little or no value, and we suggest that you concentrate on making the inverted L aerial as efficient as possible.

You will need two insulators, one at either end to insulate the aerial from the supporting masts. The small, egg-shaped insulators, made from porcelain are excellent, and can be bought for a few pence. However, you can make insulators that will do quite well by drilling holes in either end of rectangular pieces of bakelite.

SET MUST BE EARTHED

Some mains operated receivers will work quite well without a special earth wire, mainly because the power lead, which must necessarily be connected to them, has a similar effect to an earth. Furthermore, mains operated sets often have so much amplification that a big loss in efficiency can be tolerated.

In the case of a crystal set, an earth wire is essential and the more efficient it can be made the better. A waterpipe, which goes into the ground, usually makes an excellent earth. Connection to it can be made by means of a metal clip or the wire can be twisted around the pipe several times. In either case, take care to remove all the corrosion from the part of the pipe where the joint is made, to ensure a good connection.

If there is no existing waterpipe, a good earth connection can be made by driving a length of waterpipe into the ground and attaching the wire to it. A further alternative is to bury a kerosene tin or other large conducting object in the ground with the wire attached.

With the set itself finished and the aerial and earth erected, you are all ready to connect everything together and start tuning in the signals. Make sure that the aerial and earth are connected to the correct terminals: the headphone terminals may be connected either way around. Then connect the aerial crocodile clip to the tap on the coil nearest the earthed end. The crocodile clip leading to the crystal may be connected to the next tap up.

The chances are, that if you tune around the band with these settings you will hear a signal. Adjust the tuning condenser until the signal is loudest. You can then try other combinations of tappings to determine which gives the best results in your case.

In general, you will get best results with the aerial tap near the bottom of the coil, when a long aerial is used. Moving the tap up the coil reduces the selectivity and may make two or more stations audible at the same time. On the other hand, moving the tap up the coil makes the signals in the phones louder. It is simply a matter of trying several settings until you get the results you desire.

Also, try experiments with the settings of the crystal detector tap. Its effect is something similar to that of the aerial tap. There is no reason why both crystal and aerial should not be connected to the same tap if you wish, or why the crystal tap should not be lower down the coil than the aerial tap if this setting gives the best results.

FINAL ADJUSTMENTS

The setting up is a little more difficult if you have an adjustable crystal, but still not too hard. With the aerial and crystal taps adjusted as before, gently touch the surface of the crystal with the catswhisker and then try to tune in a station with the tuning condenser. If you don't succeed the first time, try another setting of the crystal, &c.

Once adjusted, you can leave the set running permanently, with absolutely no running costs.

Make no mistake about the results! At one particular location in Sydney, we are able to receive seven of the local stations, all at good listenable volume. Many home-builders will be able to do as well if not better with their first crystal set.

While all sorts of elaborations can be added to crystal sets, the best of them can result in but a minor improvement, because of the fundamental limitation that the only power available to drive the headphones is that collected by the aerial.

The most satisfactory way of improving the set is to add an amplifying valve. Next month we will tell you quite a lot about electronic valves and how they can be used in radio sets.

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GUIDED ROCKETS

(Continued from Page 9)

range of fuels for these rocket motors—among them, alcohol, hydrocarbons and aniline. But since ordinary petrol and turbine kerosene are more readily available, some of the latest rocket motors are being developed to use these standard fuels.

Three types of oxident have been tested—liquid oxygen, nitric acid and hydrogen peroxide. Ground crews using these types of propellant have to wear special protective clothing, to avoid the risk of burn from some liquids and frost-bite from others.

The hydrogen peroxide used is ten or twenty times as strong as that bought in a chemist's shop and can cause severe burns, while liquid oxygen is liable to give an operator frost-bite, unless handled with care.

It is perhaps the most spectacular of the fuels used. It is colored blue, and has normal boiling point of minus 183deg. C, so that it boils and evaporates if left out in the open in the ordinary atmosphere.

Naturally, it is intensely cold to touch; if a flower is dipped in it and then tapped on the ground, it falls into fragments as if it were made of blown glass.

HOW TO CHOOSE THE RIGHT BYPASS

In modern electronic circuits the capacitor is used more frequently for the function known as "by-passing" than for any other single application. The selection of a capacitor of the proper type and value for a given job is an important aspect of circuit design. The subject is discussed at some length in this paper prepared by Engineers of the Aerovox Corporation.

CRITICAL performance characteristics as frequency response, phase distortion, circuit stability, and freedom from parasitic oscillations are determined by the bypassing used. This discussion is intended to provide a review of this subject for the benefit of the amateur, experimenter, young engineer, or anyone who has been puzzled by the problem of what by-pass to use for a specific purpose.

The factors underlying the choice of capacitors in typical circuits will be pointed up by the use of examples.

"Bypassing" can be defined as providing a short, low impedance path around certain components for electrical currents of some frequencies, while maintaining a high impedance path for other frequencies. The circuit designer is repeatedly confronted with the need of components having this property of passing currents of a desired periodicity while excluding others.

Actually, both inductances and capacitors qualify under this definition because of the frequency discriminating action of these simple filters. An inductance, or "choke," may be considered to be a low frequency bypass element since it presents a low impedance path for DC and low frequencies while presenting a high reactive impedance for high frequencies.

SIMPLE FILTER

The condenser, on the other hand, is a simple high-pass filter, having a high reactance at low frequencies and becoming more nearly a short circuit as frequency is increased.

It is when this latter property is used to provide a "detour" around some part of a circuit that the term bypassing is most commonly employed.

For a capacitor to function as an effective bypass, its impedance must be much lower than the impedance of the circuit element being bypassed.

Of course, the reactive impedance of a capacitor of any value is easily calculated for any given frequency from the basic expression:

$$X_C = \frac{1}{2\pi f C} \qquad (1)$$

Where:

X_C is the capacitive reactance in ohms

f is the frequency in cycles per second

C is the capacitance in farads

Provided that $X_C >> X_L$. X_L = lead reactance.

Needless to say, this relationship is of constant use in designing proper bypass circuit. It shows that the reactance of a given unit decreases with frequency or that, for a given frequency a value of capacity can be chosen to give any desired value of capacitive reactance.

To aid in visualising this function, we have plotted the reactance of a .001 mfd condensed versus frequency in Fig. 1.

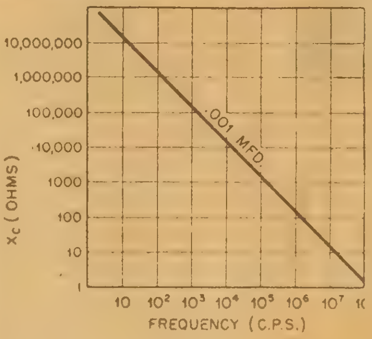
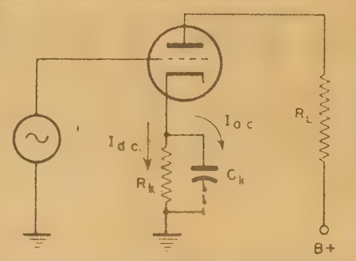


FIG.1



USE OF CATHODE BY-PASS

FIG. 2

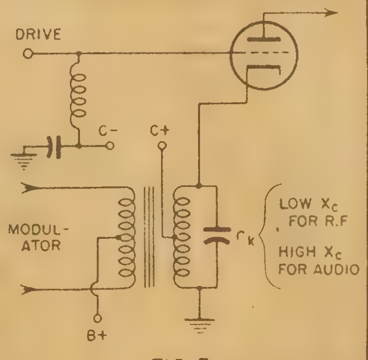
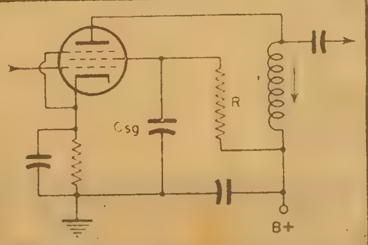


FIG. 3



SHOWING USE OF SCREEN BY-PASS

FIG. 4

The most frequent use of the bypass condenser is illustrated in Fig. 2, where the capacitor is used as a cathode resistor bypass. The necessity for this is obvious when the characteristics of the circuit are considered.

As is well known, any vacuum tube stage which uses cathode bias exhibits strong degeneration if the signal current is allowed to flow through the bias resistor. This is so, as the AC component of the plate current flowing through the bias resistor develops a voltage drop across it during signal peaks which increases the bias applied to the grid of the tube.

DEGENERATION

This has the effect of reducing the signal voltage on the tube grid and thus reducing the stage gain and introducing phase distortion and other undesirable results.

In Fig. 2, this degenerative effect is prevented by shunting the cathode bias resistor with a capacitor which bypasses the AC signal component around it. Let us now consider the requirements placed upon this capacitor.

Assume that the stage depicted in Fig. 2 is an audio amplifier intended to work over the frequency range of 200 to 5000 cps and that the cathode resistor recommended for the tube type used is 300 ohms. A bypass capacitor must be provided across this resistance which will prevent most of the audio frequency plate signal current from flowing through it.

Since the reactive impedance of the condenser becomes lower with increasing frequency, as shown by Eq. I, one which is satisfactory at the low frequency end of the desired range will do for the entire range.

RULE OF THUMB

Therefore, in the present example, a capacitor which effectively bypasses the 300 ohm cathode resistor at 200 cps should be adequate. Most circuit designers consider a ratio bias resistance to bypass reactance of about 10 to 1 to be a safe rule-of-thumb for most work. With this ratio more than 99 pc of the total AC current flows through the bypass condenser. Ratios up to 20 to 1 may be used in high fidelity amplifier work where space and economical considerations permit, however.

Assuming a bypass ratio of 10 to 1 to be sufficient, a capacitor having a reactance of one-tenth the resistance of the bias resistor at 200 cps is necessary. By rewriting Eq. 1 to solve for a value of capacitance having a reactance of 30 ohms, an answer of 26 microfarads is obtained. Therefore, the nearest standard

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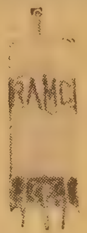
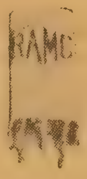


MIFI

MIDGET
BROADCAST
COILS



MA2

SA-1—Aerial Coil, Pye Wound, Shielded
SA-2—Aerial Coil, Iron Clad, Shielded
SA-3—Aerial Coil, Pye Wound, Unshielded
SRF-1—Radio Frequency Coil, Pye Wound, Shielded
SRF-2—Radio Frequency Coil, Iron Clad, Shielded
SO-1—Oscillator Coil, suits 6J8, 6A8, X61M, ECH35
SO-2—Oscillator Coil, suits 6SA7
SO-3—Oscillator Coil, Unshielded, for 6J8, etc.
SO-4—Oscillator Coil, Unshielded, for 6SA7
SIF-1—1st I.F. Transformer (Low Gain)
SIF-2—2nd I.F. Transformer (Low Gain)
SIF-3—1st I.F. Transformer (High Gain)
SIF-4—2nd I.F. Transformer (High Gain)

MA-2—Aerial Coil, Shielded, Ironclad, Tapped for Capacity Coupling
MA-3—Aerial Coil, Unshielded, Iron Clad
MRF-2—R.F. Coil, Shielded, Iron Clad, Tapped for Capacity Coupling
MO-1—Oscillator Coil, Unshielded for 1R5, Wound on .1 Meg. Resistor, with Circuit Diagram
MO-2—Oscillator Coil, Shielded for 1R5
MO-3—Oscillator Coil, Shielded for 6AN7/6J8.
MO-4—Oscillator Coil, Shielded, for 6BE6.
MO-5—Oscillator Coil, Unshielded, for 6AN7/6J8
MO-6—Oscillator Coil, Unshielded, for 6BE6
MIF-1—1st I.F. Transformer (High Gain)
MIF-2—2nd I.F. Transformer (High Gain)
LA-1—Loop Aerial, designed for High Gain and Maximum Pick-up; includes Loading Coil and Resister supplied with Circuit Diagram

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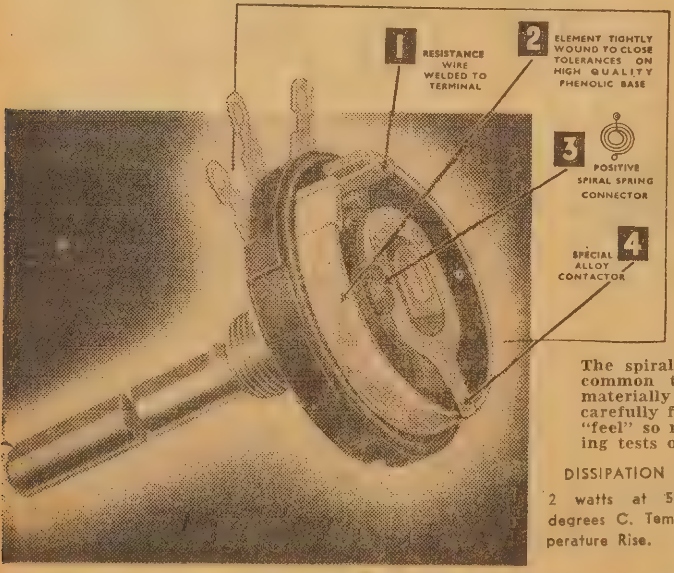
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DISSIPATION	SHAFTS	RESISTANCE VALUES	DIMENSIONS
2 watts at 50 degrees C. Temperature Rise.	1/4" diameter. 3/8" bushing. Standard shaft length 2 1/4" from front plate to end of spindle.	All ranges from 5 ohms to 10,000 ohms. Standard tolerance plus-minus 10 pc.	1 1/4" diameter. Depth from mounting face, 9/16."

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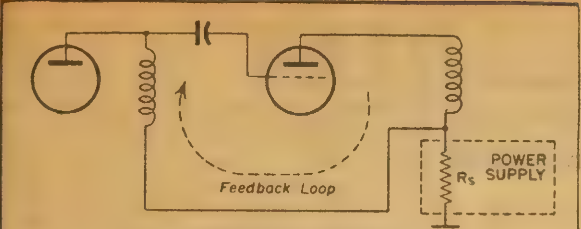


FEEDBACK DUE TO COMMON POWER SUPPLY IMPEDANCE

FIG. 6a

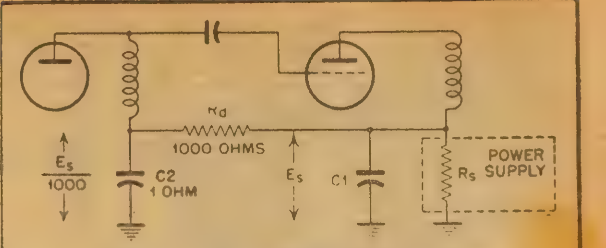


PLATE LEAD DECOUPLING FILTER

FIG. 6b

value of 25 microfarads would be used.

An electrolytic condenser is usually used in this application since leakage resistance is not important in this case and these units are compact and economical. The capacitor must be rated for a working voltage greater than the maximum bias voltage developed.

OHM'S LAW

This may be obtained from Ohm's Law, using the bias resistance and the maximum DC current which flows through it. For pentodes, this means both the plate and screen current, and for classes of amplification other than Class A requires the maximum-signal current. A voltage rating of 25 or 50 volts is usually sufficient for cathode bypassing.

In the example discussed above, the cathode bypass could have been made large without limit, without detrimental effects on circuit performance.

Circuits exist, however, in which there is an upper limit to the capacitance which can be used to bypass an impedance in the cathode circuit. As an example, consider the cathode-modulated Class C r.f. amplifier shown in Fig. 3. Here the condenser is required to bypass r.f. around the modulated transformer.

Otherwise regeneration may result from feedback into the grid bias circuit. However, if the cathode bypass is made too large, the modulation frequencies will be shunted to ground. A value of capacitance must be chosen which has very low reactance at the carrier frequency, but a high one at the highest modulation frequency.

RF REACTANCE

Fortunately, this is easily done in this case because of the wide difference in the frequencies involved; a .002 microfarad condenser has a reactance of about 8.0 ohms at an r.f. frequency of 10 Mc, but almost 16,000 ohms impedance at 5000 cps. A good mica or ceramic condenser of low inductance would be used in this application.

Of course, not all cathode bias resistors must be bypassed. In many high fidelity audio amplifiers and television i.f. amplifiers controlled amounts of negative feedback are introduced to improve the overall performance. In such cases, the loss of gain is compensated by adding extra stages.

Cathode bypassing is also omitted in Class A push-pull amplifiers, since the AC signal components of both tubes flowing in the resistor are out of phase and cancel out.

The screen element of tetrode and pentode electron tubes must be effectively bypassed to ground for all signal voltages present. This is necessary to prevent degeneration of a type very similar to that discussed above.

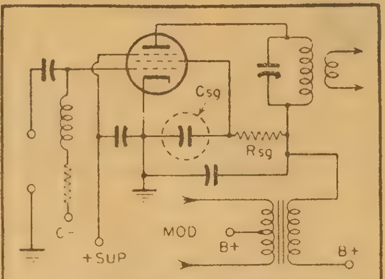


PLATE-SCREEN MODULATED PENTODE STAGE SCREEN BY-PASSED FOR R.F. (Csg)

FIG. 5

For example, consider the television IF amplifier stage shown in Fig. 4. Here the screen voltage is derived from the plate supply through a dropping resistor. If the AC signal component is allowed to pass through the screen dropping resistor, the gain of the stage will be reduced.

SCREEN BYPASS

For this reason, a bypass condenser is used to ground the screen for signal voltage without interfering with the application of the DC screen voltage. If the screen bypassing is imperfect at any frequency, the response of the amplifier will fall off there or it may oscillate.

It is common practice to make the screen bypass reactance small compared with the cathode-to-screen impedance. This is obtained by dividing the screen voltage by the screen current.

Mica or ceramic condensers are used in values ranging from 100 micromicrofarads to 0.1 microfarads for radio frequencies, while high quality paper units and electrolytics are used for audio screen bypassing. As in cathode resistor bypassing, certain circuits require screen bypassing sufficiently heavy to ground the screen for RF but not for audio frequencies.

A typical example of such selective by-passing would be the plate and screen modulated Class C amplifier shown in Fig. 5. In this circuit the screen voltage must vary with the modulation and so should not be by-passed for audio frequencies. A .002 microfarad condenser is sufficient in most cases and does not result in a loss of "highs."

As in the cathode and screen circuits discussed above, any impedance in the plate circuit of a vacuum tube stage which is common to another stage, or another part of the same stage, can cause feedback and instability if not properly bypassed.

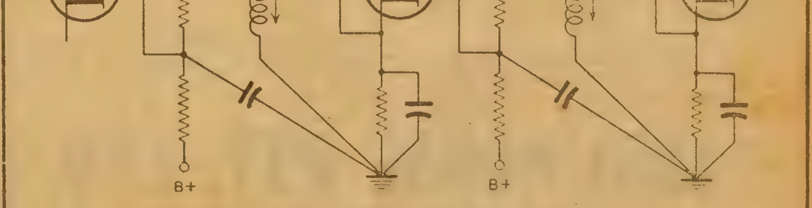
COMMON IMPEDANCE

The reasons for this are obvious from Fig. 6a. Here the plate voltage for two stages of an IF amplifier are taken from the same power supply and no decoupling is employed. The internal impedance of the power supply is represented by Rs.

Since the plate signal current is allowed to flow through Rs, a voltage drop is developed across it which is introduced into the plate circuit of the preceding stage via the plate lead. This signal voltage is then fed to the grid circuit of the second stage with the result that oscillation will occur if the stage gain is high enough.

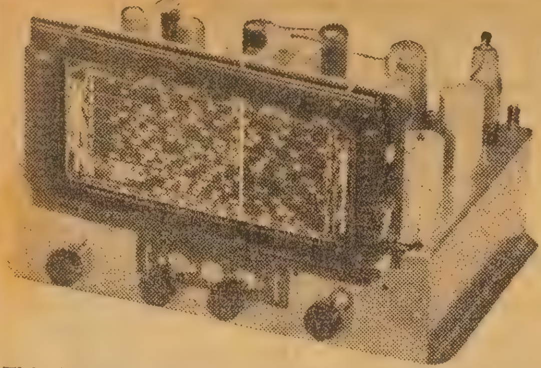
Instability due to plate circuit feedback is prevented by the use of decoupling filters consisting of series isolating resistors and bypass condensers shown in Fig. 6b. Such decoupling networks are most easily understood if thought of as voltage dividers at the feedback signal frequency.

For example, in Fig. 6b assume that the internal impedance of the power supply (Rs) is imperfectly bypassed by C1 at the signal frequency. A small signal voltage (Es) is therefore developed across the



ILLUSTRATING USE OF BY-PASS GROUND POINTS

FIG. 7



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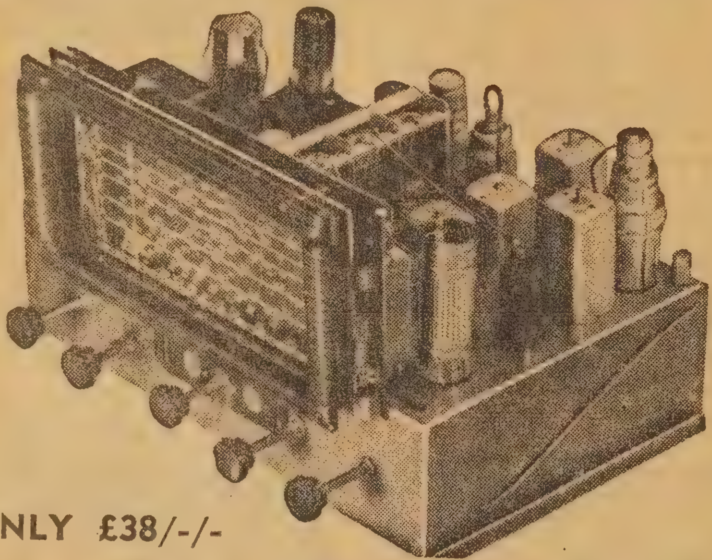

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power supply impedance and travels down the plate lead to the preceding stage.

The function of the decoupling filter Rd and C2 is to greatly attenuate this signal since they divide it in the ratio of their impedances. Thus, if the reactive impedance of C2 is only 1 ohm and the resistance of Rd is 1000 ohms, the feed-back signal is divided by that ratio so that only 1/1000th of the voltage developed across the power supply impedance is applied to the preceding stage.

Of course, the DC plate voltage is unaffected except for a small IR drop across Rd. In cases where this drop couldn't be tolerated, an inductance could be used in place of Rd. Several such RC or LC decoupling filters are sometimes used in series in cases where feedback is particularly troublesome.

SINGLE EARTHS

Bypass wiring in some circuitry, including high gain amplifiers and VHF circuits, must be done with extreme care to avoid common impedances which introduce feedback. The safest rule for by-passing multi-stage amplifiers is to ground all by-passes associated with the output of one stage and the input of the next stage to a single ground point, as in Fig. 7.

In applications where very effective bypassing at a single frequency is required, some designers have resorted to the use of series resonant by-passing. By this method, the capacitance of the condenser is resonanted with the inductance of its wire leads to obtain the theoretically zero impedance of a series resonant LC circuit.

The self inductance of certain types of windings can be used and capacitors made which will have self resonant characteristics at any frequency. Such capacitors have been used in I.F. by-pass circuits of AM receivers to trap I.F. voltages.

The self-resonance of the capacitor may be found by connecting the ends of the leads together and measuring the frequency at which this L-C combination produces a response on a grid-dip meter or other absorption indicating device.

SELF-RESONANCE

The exact length of the wire lead to be used in the circuit must be used in this measurement for precise results. This is illustrated by the fact that the resonant frequency of a tubular .01-mfd unit having leads of 20 guage wire ½-inch long is about 11 mc. However, if the leads are trimmed to 1/8-inch, the self-resonance is raised to about 40 m.c.

For capacitor types which do not have flexible lead wires, the terminals may be connected by a wire of known or calculated inductance and then correcting for this added inductance to find the true resonance.

Dual bypassing is frequently used where effective bypassing must be provided over a wide band of frequencies. A small, low inductance unit for r.f. is connected in parallel with a large condenser of poorer quality for audio frequencies.

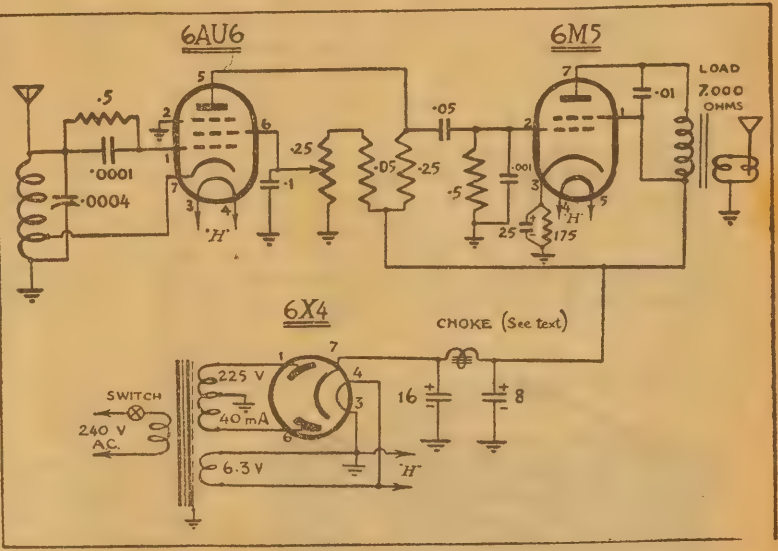
The high capacitance unit, if used alone, would contain too much residual inductance to be effective for r.f. and economy prevents the use of a mica or other high quality condenser of sufficient capacity to by-pass all frequencies.

A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

A THREE-VALVE AC MANTEL RECEIVER

Here is a contribution from Mr. C. W. Jones, of 53 Morrison Rd., Gladesville, NSW. We are presenting his own description almost in full and producing a block of the actual circuit diagram which he submitted.



HAVING been requested to build a mantel radio "quite small, compact and economical, with adequate speaker volume and no 'messy' aerials," I cast my mind back to the regenerative type of receiver and decided to use this principle in conjunction with modern miniature valves, a home-made coil unit, and odds-and-ends usually found in the familiar "junk-box."

The result is a three-valve set constructed on a chassis measuring 6" x 4" x 2" and using a 3" speaker. It performs amazingly well. The circuit is similar in some respects to one described in "R & H" some time ago.

Using 1½ft of aerial merely coiled within the cabinet, this miniature mantel separates all the Sydney stations at more than ample volume, and many country and interstate stations can be tuned in with ease.

SMOOTH CONTROL

The regeneration is very smooth, the control for which is handled exactly as a volume control, and, in this set, for the same purpose.

The excellent performance is due to two high-gain miniature valves, a 6AU6 as detector and the 6M5 as power output valve. A miniature 6X4 rectifier handles the HT current.

The standard 225 volt 50 mA power transformer is employed, while the filter "choke" is a miniature 5000 ohm speaker transformer (disposals) the secondary of which is not used. A 14 Henry 60 mA choke should be used if one of these is not available.

A similar transformer is used for the 3" speaker, although, from the 6M5 data, a 7000 ohm load is recommended. In the original, the filter choke was mounted above the chassis, the speaker transformer directly beneath it, two bolts holding the two in place.

I have found that a 16 mfd filter condenser before, and an 8 mfd condenser after the "choke" provides ample filtering, and under ordinary close-listening conditions hum is at a minimum.

Fixed tone compensation is provided by the .001 mfd condenser shunting the 6M5 grid resistor, and by the .01 mfd condenser between the plate of the 6M5 and the high tension line. This eliminates the high frequency "peaky" nature of most 3" speakers. There was no need in the original to include suppressors in the grid or screen of the 6M5 valve.

For tuning, one section of a miniature 2-gang capacitor of the type using a solid dielectric proved ideal with the home-made coil. This coil consists of 140 turns of about 32 gauge B & S on a ¾" diameter former, with a tap (for cathode connection) at 6 turns from the earthed end. The wire used in the original coil was taken from an old speaker transformer.

SIMPLE DIAL

No elaborate dial is used, because this set is intended for use on the broadcast band only. A white pointer knob and a home-made scale suffices. To the left is an on/off switch and on the right is the regeneration control, which, because of its smoothness in operation, is called the "volume" control by the other members of the household. Both of these controls have miniature white knobs attached.

The speaker is mounted at the centre front of the chassis, which fits snugly into a home-made cabinet. The cabinet is lacquered white and sealed at the back with a masonite panel to keep out the dust. Sufficient relief from back-pressure from the speaker is afforded by a grill cut on each side of the main speaker opening in the front panel. Some pale blue speaker cloth "sets off" the finished job.

For readers living in the country or the most distant suburbs, a longer aerial is preferable, but a small aerial trimmer of about 30pf should be connected between the coil and the aerial to prevent unnecessary overloading.

When the aerial is of such a length that ample volume is obtained without the stations overlapping, paint the stations numbers on a small scale and insert this behind the pointer knob. Any alteration to the length of the aerial will alter the setting of the stations.

So much so for a high performance, low-cost, easily built receiver which should appeal to the beginner as well as the more advanced constructor.

AN electronic ash recorder, developed locally, measures dust output from boilers. A 6in dia. sampling tube is fitted across the induced draft fan. Ports in the tube admit air because of a negative pressure in the tube.

A phototube setup permits detection of ash via a pulsating direct current which flows in the cathode resistor of the tube. Frequency of the alternating-current component depends on number of shadows per second affecting the cell because of light absorbed by dust particles. The alternating-current component is amplified and applied to a direct-reading frequency meter.

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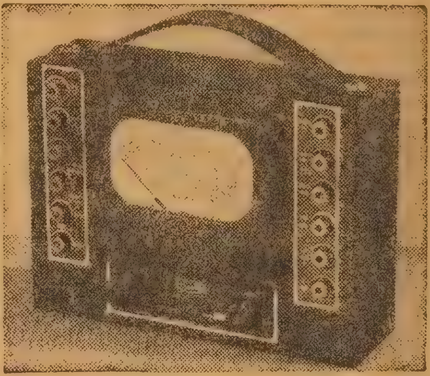
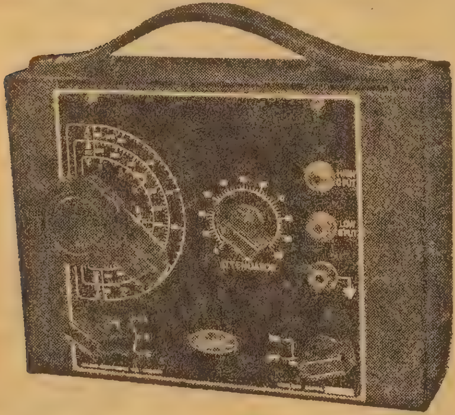


The carefully designed and engineered MK1 Multimeter Kit comes to you complete in every detail. All Resistors, Shunts, Meters, etc., are carefully pre-calibrated to an accuracy of 1 per cent and no further calibration is necessary. It has a wide range of A.C. and D.C. voltages up to 1000 volts and current can be measured in these ranges: 1, 10, 50 and 250 Milliamperes. Self-contained for resistance readings which are up to 100,000 ohms. The popular 4" square type meter with a clear Muti-Scale is used. All wiring instructions and constructiontal details are given with the Kit and photographs and circuit diagrams make it simple.



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ATOM POWER WILL NOT OUST COAL

(Continued from Page 5)

asted nowadays. Rare metals like rmanium are mined with some als and a survey is starting on just hat is available in one of the South 'ales coalfields.

Though the field has been worked r nearly 100 years it is still true say that no one really knows what there and what has been wasted uring all the years passed.

Apart from the other things found ith coal and the by-products of al there are many chemical uses for coal itself, pure but not modified. It is used for the reduction of metallic ores.

Electrode carbon for the manufacture of aluminium has been made from particularly pure coal, though normally these electrodes are a product of the petroleum industry. From the coal tars given off when coal is coked come a whole family of chemicals which make everything from nylons to drugs.

In fact, the Research Establishment is trying a new cheaper and quicker method of making antrycide the wonder-drug which is preventing, and curing infections of trypanosomiasis in cattle in the tsetse belts of Africa.

It has been found that the structures of carbon and hydrogen in coal tar are particularly suitable for drugs, and aspirin and M and B 693 are already well-known products.

So it is that though many of these research lines are in the nature of medium or long-term projects their commercial application can be expected to be accelerated by the high price of British coal. Eventual results will almost certainly include a reduction in the price of solid fuels.

NEW TYPE OF V.H.F.

(Continued from Page 17).

Thus the range ot a VHF transitter cannot truly be said to be mited to the distance of travel of the round or tropospheric waves, but at the return of a certain amount f energy from the ionosphere to eater distances is possible.

The geometry of the transmission ath would indicate that the range r a one-hop transmission would be mited to about 1250 miles by the arth's curvature and it is underood that the transmissions have een widely received by radio amaeurs within that distance of the ansmitter. An attempt to receive gnals at a distance slightly greater an this resulted in reception only eing obtained when Sporadic E was resent.

As to the possible uses of the sysem, there would appear to be sevral, mainly in the nature of point-o-point communication. It appears, owever, that multi-hop transmision would call for the expenditure of normous power at the transmitter, nd this would seem to limit the ses of the system.

PENNSYLVANIA TURNPIKE

(Continued from Page 19)

When handling traffic from cars, owever, the system operates as a uge party phone, with all mesages eing heard over the respective halves f the turnpike.

Thus, all messages from cars are eceived at the nearest relay on HF, then fed into the UHF sysem in both directions to cover the ntire half-section of the highway.

Conversely, messages for the cars r fixed stations are fed to the elay stations via UHF, then transnitted on the cars' VHF listening requency.

Since all parties hear all such raffic, it is possible for one car to onverse, through the relay chain o another elsewhere on the highway.

In case of emergency, should the JHF link fail, communication can still be had using the VHF channel nly.

The system is under the control of an operator for each half of the urnpike, who has available two voice and one teletype channels.

In vehicles, toll booths, &c., no radio equipment is visible, the only items in evidence being a speaker and a handset.

(FM-TV Radio Communication, May, 1952.)

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MORE ABOUT THE “ELECTRO-FLASH”

Since building and describing the Radio and Hobbies Electro-Flash featured in last month's issue we have had the opportunity to use and test it under a wide variety of conditions. The results of these tests, plus other useful data on using the unit, forms the basis of this article and should assist materially in getting the best possible results from it.

by Philip Watson

WE have also had the opportunity to test a number of components which various manufacturers have made available in anticipation of readers' demands, and some commentary on these may assist the reader in his selection of some of the not-so-standard parts.

First, however, let us deal with two modifications to the circuit proper; one of which should be regarded as essential, while the other is optional.

TRIGGER CIRCUIT

The first, and essential, one concerns the triggering circuit.

With the component values originally quoted triggering was quite positive when only a short length of cable, as from the gun to the camera, was involved, but showed a tendency miss on odd occasions when a long cable was used or when the contact arrangement introduced any appreciable resistance into the circuit.

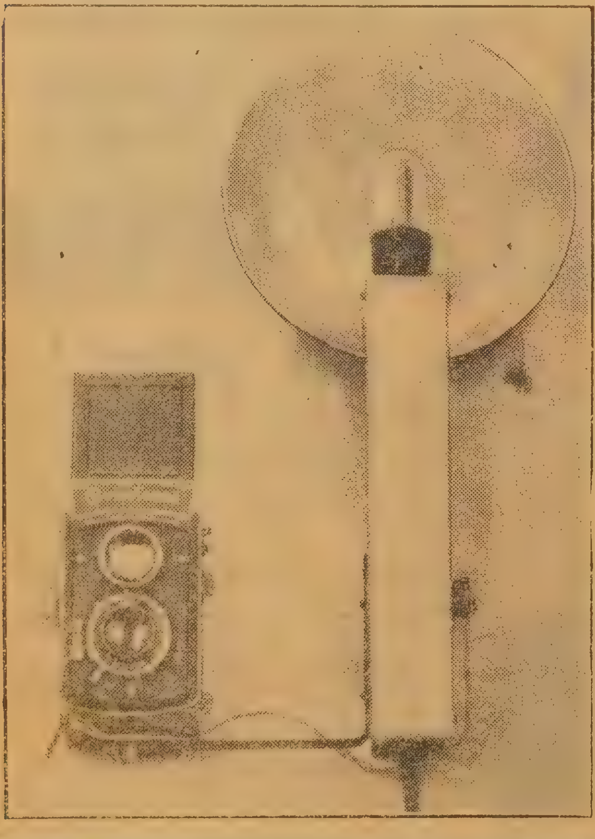
This trouble was overcome by increasing the value of the trigger capacitor to .5 mfd and it was found possible to accommodate this value in the gun by selecting one of the miniature 350 volt types.

POLARITY

Some slight modification to the layout was necessary, the original tag strip which held the two .1 mfd capacitors being removed and the .5 mfd being mounted in its place immediately above the triggering transformer. To accommodate the connections to the frame and triggering transformer a two terminal tag strip, with one terminal earthed, was mounted on the opposite side of the gun.

While on the subject of triggering transformers, there is one point which we neglected to mention in last month's article and that is the matter of triggering pulse polarity.

If the transformer is connected the wrong way round the tube will not ironise, or at the best will only fire on odd occasions, much depending on whether the triggering circuit will oscillate to provide the correct polarity pulse of sufficient amplitude. There is no simple way of telling what are the correct connection and it is best determined by experiment before the wiring is made permanent.



This picture shows how the flash gun is attached to the camera by means of a small metal bracket anchored to the tripod socket with a ¼" Whitworth screw. The socket for the trigger circuit would be more convenient if located slightly higher and this modification is possible when the miniature neon lamp is used.

☆

The second modification which we tried, and found very successful, wa the one we suggested last month whereby the neon indicator could be switched to two points on the voltage divider, thus providing two degrees of charge.

The idea is that the lower charge will probably be sufficient in many cases and, when it is, it is convenient to be able to take advantage of the faster charging time and reduced battery consumption which it makes possible. At the same time the higher rating is still available for the odd occasion when it may be really valuable, the only requirement being the increased charging time.

We first tried the idea with the pilot socket type neon originally fitted to the gun but found that the presence of the current limiting resistor in the base made it difficult to maintain oscillation when connected across certain values of the voltage divider. To overcome this we substituted a miniature neon which should be readily available by the time this appears in print.

These are about ¾in long and ¼in in diameter and are supplied without any base or series resistor, making it possible to connect the oscillator capacitor directly across them. With this arrangement there is no difficulty in obtaining oscillation at any tapping on the divider, and it is simply a matter of determining the correct tappings to provide indication at the required voltages.

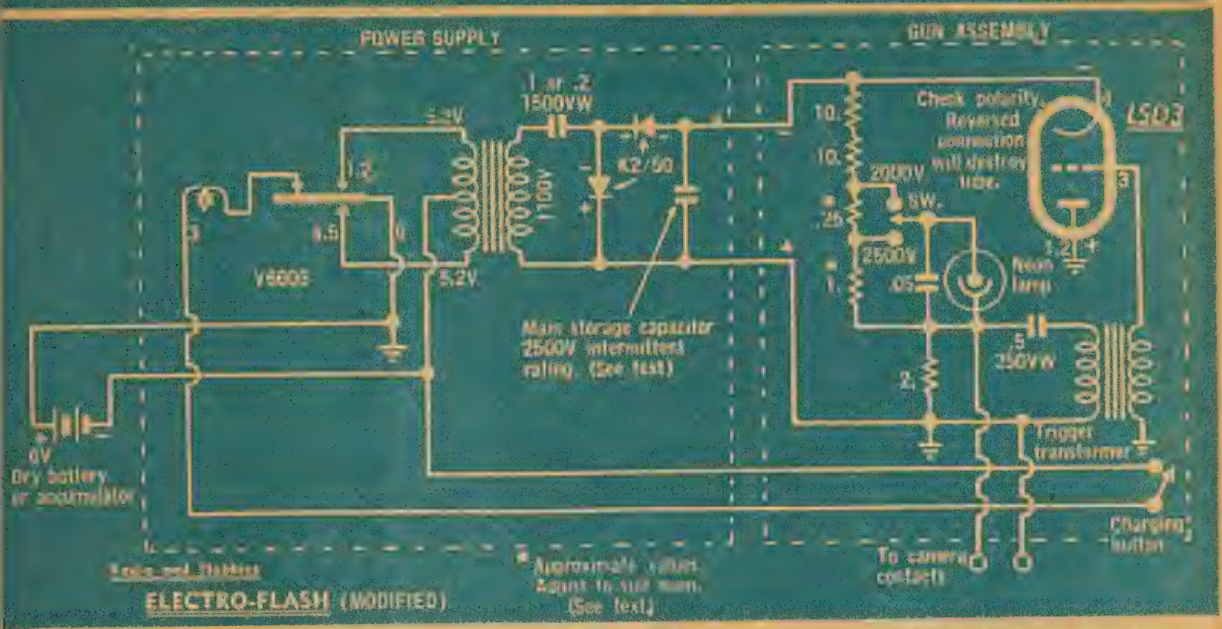
SWITCH SIMPLER

At one stage it occurred to us that two neons, one arranged to flash at each of the selected voltages might be a simpler arrangement than using a switch to change one neon to different tappings. Only objection to the scheme is that it is difficult to get two neons which strike at approximately the same voltage and juggling values of voltage divider sections to match two different neons can be something of a tall order.

All things considered, we decided that the switching arrangement was the simpler of the two.

The switch is a standard single pole, two position toggle type and is mounted near the bottom of the gun, although, with the larger neon removed there is no reason why it

CIRCUIT PROVIDES HIGH AND LOW LIGHT OUTPUT



The two modifications mentioned in the text are shown in this circuit. One involves an increase in capacitance in the triggering circuit and the other provides a means of selecting either a high or low charge rate, according to the position on the voltage divider to which the neon is switched.

could not be mounted in the space thus made available. In this way it might be possible to reduce the length of the gun slightly if so desired but you can please yourself in this regard.

Because of the variable striking voltage already mentioned it is not possible to give exact values for the tappings on the voltage divider, and it will probably be necessary for these to be found by experiment in each case.

For the tube we used a value of 1.3 megohms was required for the 2000 volt condition, being made up of a 1 megohm, a .25 megohm, and a 50,000 ohm. For the 2500 volt condition the neon is switched to the other side of the .25 megohm, placing it across 1.05 megohm. All the resistors are .5 watt.

CHARGING TIMES

A little leeway is possible in regard to the voltages at which the neon strikes, since the speed of the oscillation can be taken as a fairly accurate indication of the state of charge and may be used to compensate for slight variations from the ideal.

The dual charge facility is particularly valuable when working from dry batteries since although these are mainly useful for charges of 50 joules or less, it is possible to obtain an 87 joule charge (2500 volts across 28 mfd.) provided the added charging time is not an inconvenience. This will be in the order of 15 to 20 seconds compared with seven to 10 seconds for a 56 joule charge, using two lantern batteries in parallel.

Whether this longer charging time is convenient or not will depend to a large extent on the type of work being done. For the straight-out amateur it will probably be quite satisfactory; for the professional who can depend on his subjects for a certain amount of co-operation it is not likely to be more than a slight inconvenience; but for the press photographer, who must get his picture, it would be far too long, a figure of less than five seconds being desirable.

While on the subject of dry batteries we feel bound to state that some makes appear to be more satisfactory in this class of service than others, there apparently being a considerable difference in the internal resistance of various brands.

We would hasten to point out that this is not meant to infer that any one manufacturer makes a better or worse battery than any other, since it is probable that, when used for the service originally intended, there would be very little to choose between them.

However, this is definitely not the class of service for which these batteries were designed and, in fact, it is asking a lot of them to withstand such heavy discharges. Thus it is not surprising that some makes may happen, quite by chance, to have characteristics which make them somewhat more suitable than others.

Some idea of the life to be expected from these batteries can be judged from the following: Two lantern batteries in parallel have so far provided over 70 flashes, each of 87 joules, and still have some useful life remaining.

However, the charging time commenced to lengthen noticably after about 60 flashes and is now around the 25 seconds mark for an 87 joule charge, indicating that the end of life point will be largely determined by the maximum permissible charging time.

RUNNING COSTS

On the basis of 72 flashes from such a set of batteries, the running cost, on the present retail price, works out at about 2d per flash — which is a good deal cheaper than the cheapest flash bulb. Another way of comparing the cost is to realise that you can buy power for at least 72 flashes for approximately the price of five of the cheapest expendable flash bulbs.

When using an 18 mfd capacitor it appears that four cycle lamp batteries are capable of giving satisfactory performance, giving a 56 joule charge in eight to 10 seconds and a 34 joule charge in approximately 5 seconds. A single lantern battery would be still lighter in weight but would almost certainly increase the charging time to some extent.

Next comes the all important question of synchronising the firing

DANGER

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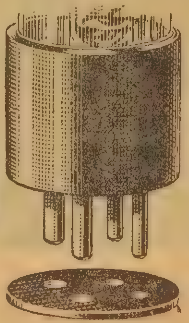

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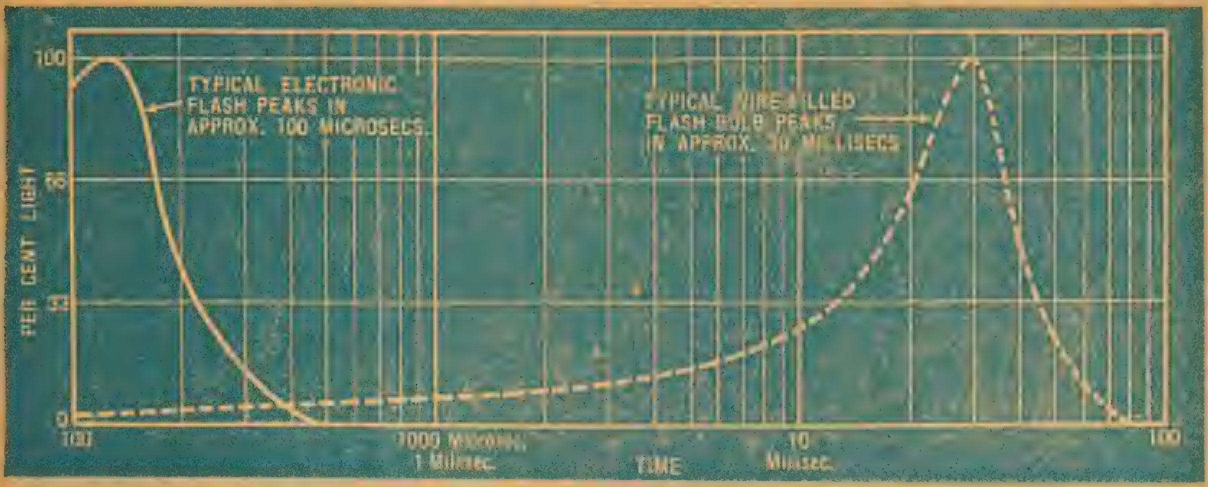
FIRING TIME OF ELECTRO-FLASH AND FLASH BULB



This graph gives some idea of the difference in firing speed between the electronic flash and the ordinary flash bulb. Note particularly that the time scale is logarithmic—the only way we could get both curves on the one graph, so great is their difference. The graph is not intended to compare the difference in light output.

of the flash with opening of the shutter blades, a process which is not as difficult as it may at first appear.

Although exposures may be made by closing the trigger circuit while holding the shutter open on the time or bulb setting, such an arrangement is seldom satisfactory except for experimental work. The normal arrangement is to utilise a pair of contacts operated by the camera-shutter and so arranged that the circuit closes at the moment that the blades reach the full open position.

The main objection to the purely manual arrangement, apart from the inconvenience, is that there is always the possibility of a secondary image due to the normal lighting of the scene. Thus the ideal arrangement is to have the shutter blades open for no longer than is absolutely necessary, and the brighter the normal lighting relative to the intensity of the flash, the faster must the shutter speed be, in order to eliminate the secondary image.

FLASH DURATION

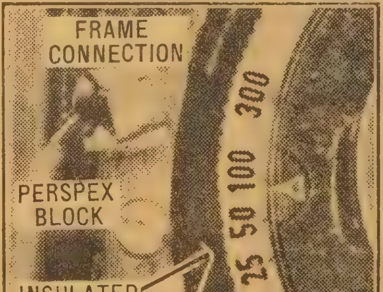
Since the duration of the flash is so very much shorter than the fastest time in which even a modern shutter can open and close, it is simply a matter of ensuring that the flash will fire at the moment that the blades are fully open, it being quite definite that the flash will be over long before the blades can close again.

Most modern cameras, even the cheaper ones, are fitted with shutters having flash contacts, and a few words about these contacts may be helpful. Although originally intended for use with the expendable type of flash bulb, they are quite suitable for use with electronic flash; in fact, in many ways they are more suitable.

In order to understand this a little better it is necessary to compare the characteristics of the two types of flash, particularly as regards the delay before firing after the circuit is closed. In this regard the expendable bulb is relatively sluggish, requiring between 20 and 30 milliseconds (approximately 1/50 to 1/30 of a second) to reach full light output.

Thus, when using these bulbs, it is necessary to either leave the shutter open long enough to allow the flash to reach full output, or to arrange some means of delaying the shutter opening until this condition is reached. The latter arrangement calls for a device called a synchroniser, which is attached to the shutter release mechanism and allows the flash contacts to be closed as soon as the cable is pressed, but delays the operation of the shutter for the time required by the bulb.

When such devices are properly adjusted it is possible to operate the shutter at any speed up to its maximum, thus making possible high-speed shots by artificial light. The contacts fitted to most modern shutters, however, are simply arranged to close at the same time as the shutter is released, and, since there is no means of providing the required delay, it is necessary to use one of the slower speeds, usually not faster than 1/25, when the slow-firing, expendable bulb is used.



Showing how the shutter operated contact system was fitted to the Rolleicord. Though rather crude in appearance it has functioned perfectly and the general idea will probably be retained in a more permanent form.

In the case of the electronic flash the position is quite different. The whole process is extremely rapid and the tube commences to emit light only three or four micro-seconds after the circuit is closed, reaching a maximum output in from 100 to 150 micro-seconds, and being virtually finished after only 200 to 300 micro-seconds.

Since 1000 micro-seconds equals one milli-second and 20 milli-seconds are required for a flash bulb to reach its peak, it is easy to appreciate the vast difference in firing time between the two systems.

Because of the virtually instantaneous response by the electronic flash, there is no need for any synchronisers or delay systems, and the ordinary contacts fitted to modern shutters should be quite satisfactory even when the shutter is used at its top speed.

CHECKING THE SHUTTER

In any case it is quite a simple matter to check whether the shutter is fully open at the moment of flash, it only being necessary to open the back of the camera and look through the lens at the flash as the shutter is operated.

The diaphragm should be fully open for this test and, if all is well, the full circle of the lens will be visible at the moment the flash fires. If the shutter blades are visible partly open, it is likely that the contacts are closing too early, and they should be adjusted by a camera mechanic.

There are, of course, a great many prewar cameras which are not fitted with contacts but, being perfectly good in all other respects, their owners are not inclined to dispose

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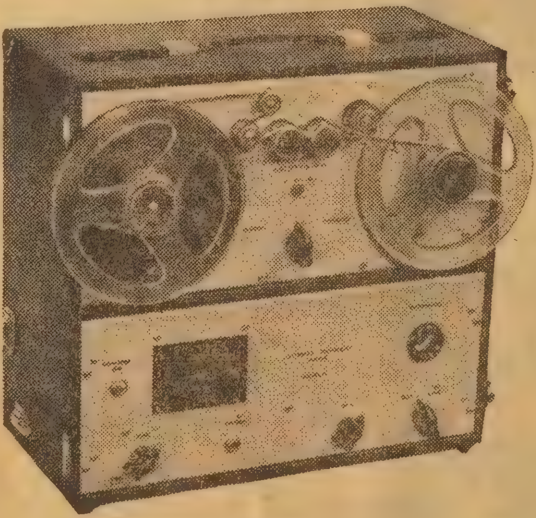

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of them in favor of a more modern version simply to acquire a shutter with contacts. Many camera mechanics will fit contacts to these shutters but a fair amount of fine mechancial work is involved and the job is likely to be an expensive one.

There is, fortunately, an alternative arrangement which comes within the scope of most amateurs who possess a reasonable amount of mechanical skill and which does not involve "butchering" the camera in any way.

This takes advantage of the fact that the loading lever, as fitted to most of the better quality shutters, such as the Compur, always moves with definite relationship to the position of the shutter blades during the exposure cycle.

SIMPLE SET-UP

This point can be checked quite easily by loading the shutter and then releasing it with the loading lever firmly held. If the loading lever is now allowed to move slowly the shutter blades will be seen to open and the position of the loading lever, relative to the body of the camera, can be noted when the blades are just approaching the full open position.

If an insulated contact leaf is mounted on the frame of the camera so that the loading lever touches it at this point the circuit may be completed through the frame of the camera and the flash will be automatically fired when the blades are in the correct position.

There is only one possible objection to this arrangement, though not a serious one, and that is that the contacts are closed both when the shutter is fired and when it is loaded. Thus it becomes necessary to load the shutter before the charging cycle is commenced, otherwise there is the chance of wasting a flash.

This is not serious with the electronic flash as it would be if the same scheme were used for flash bulbs.

All the work done so far with this flash unit has used a set of contacts as described above, the camera being a prewar Rolliecord without contacts. The arrangement is shown in the accompanying photograph and although it is a rather crude affair, rushed together at short notice to enable the unit to be tested, it has proved quite satisfactory It is planned to fit a more presentable arrangement as soon as time permits.

CONSTRUCTION

As it stands it consists of nothing more than a small block of perspex mounted by two screws which fit into threads already present in the body of the camera. To this block is fixed a small contact leaf of spring brass which is adjusted so that the loading lever just touches it as it sweeps past, no difficulty being experienced in locating it correctly with reference to the "shutter open" position.

For cameras with similar types of shutters it is still possible to arrange a contact system, though it is not possible to use high shutter speeds (being more in the nature of a very quick "bulb" exposure) and the intensity of normal lighting must be kept to a minimum if secondary images are to be avoided. At the moment we are working on such a device and we will probably publish constructional details next month.

The next point for consideration is the effect of development on effective speed of the film. As mentioned in the July issue, films subject to extremely short exposures suffer from what is called reciprocity failure, or the failure of the film to respond to an increase in lens aperature which is a direct reciprocal of the decreased exposure time.

SPEED AND CONTRAST

The exact cause of this failure appears, for the present, to be something of a mystery, which is not surprising since it no doubt involves the basic principles of photographic emulsions and this is a subject which is by no means fully understood at the present time.

Nevertheless, the practical results can be readily observed, and there seems little doubt that the reciprocity failure acts in two ways, and that both effectively reduce the speed of the film. The first effect is the one already mentioned and simply infers that there is a straight-out effective loss of light. The only cure for this is to adjust the exposure accordingly.

The second effect concerns the contrast of the emulsion. This appears to be considerably reduced by the reciprocity failure, particularly in the "toe" portion of the characteristic curve which is widely used for negative making, with the result that a correctly exposed negative may appear similar to one which is under-exposed to the point where contrast is reduced, though most of the detail is still visible.

By increasing the exposure it is possible to use the straight portion of the characteristic curve, which is normally much steeper, and this will restore the contrast, but the necessary increase in exposure is seldom convenient.

The other alternative is to increase development time, thus restoring the characteristic curve to something like its original slope. This appears to be a perfectly satisfactory arrangement, providing it is not carried to the point where increased fog and grain become serious, grain in particular being rather critical in this regard.

50 pc INCREASE

The exact amount of development increase has been variously quoted as from 30 pc to 100 pc, with a majority in favor of about 50 pc. In order to determine just how effective this increase would be, it was decided to compare negatives exposed under identical conditions, but developed both for the normal time and normal time plus 50 pc. The manner in which this was done may be of interest to readers.

First, the light was set up at a fixed

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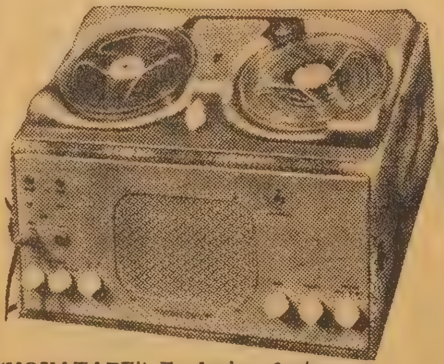

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distance from the subject (6ft in this case) and six exposures were made, commencing with a stop of f5.6, and followed by stops of f8, 11, 16, 22 and 32. Then, on the same roll of film, these six shots were repeated, care being taken to see that all conditions were identical.

The completed roll was then placed in a tank and given the normal development time in Microdol developer, after which the developer was poured off and the film rinsed with clean water. The tank was then opened in the safest light available, and the first six exposures unwound from the spiral, cut off, and placed in clean water. The remaining film was returned to the tank and developed for a further period equal to 50 pc of the original time.

DIRECT COMPARISON

Slight fogging occurred on this second length of film, which was more or less expected, but only on the first and a small part of the second exposure which were too dense to be of any real value. The remaining exposures on each strip provided a direct comparison between the two development times.

From this it would appear that our original suggestion of a guide number of 60 for an 87 joule charge is correct when normal processing is followed, but that this can be increased by approximately one stop, making a figure between 85 and 90, when the development is increased 50 pc. The increase in overall fogging is negligible while the effect on grain is only apparent at extreme degrees of enlargement.

Since Microdol is essentially a fine grain developer, the makers do not claim that it produces either the maximum speed of the emulsion or the maximum contrast when exposures are approaching the under-exposure region.

For these conditions they recommend that D76 is more suitable and, although we have not had a chance to try this developer, it would seem almost certain that there would be some increase in emulsion speed, as well as increased contrast. However, the 50 pc increase in development time would still appear desirable.

EFFECT ON GRAIN

Whether the resultant grain would be excessive would depend largely on the size of negative involved, but it must be remembered that D-76 is still in the fine grain class, being designated as a medium fine grain developer, as distinct from Microdol, which is classified as an ultra fine grain type. Providing the subject can be made to fill the negative area as completely as possible it is not likely to prove troublesome except, perhaps, in the case of 35 mm.

All the above exposure figures are based on the assumption that an efficient reflector is used, and we cannot emphasise too strongly the need for care in the choice of this item. It is extremely important that it be designed for use with this type of light rather than the expendable flash bulb since a large proportion of the latter type are woefully inefficient.

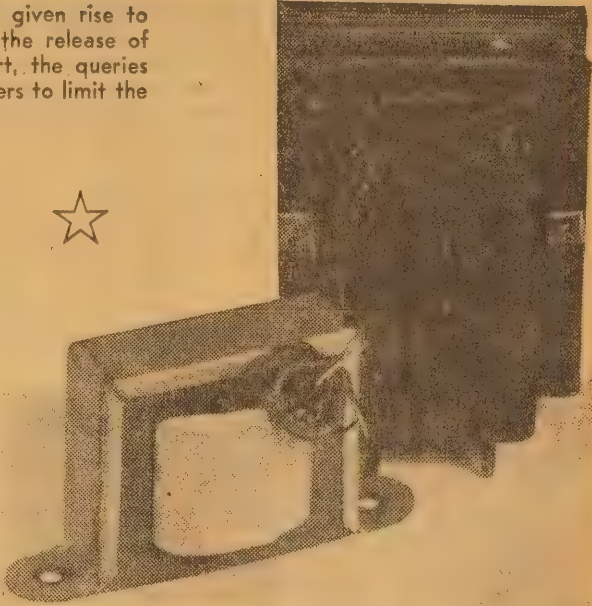
In fact, it appears that many of them have been deliberately designed in this way in order to prevent over-exposure when used with flash bulbs under open flash conditions at close range, and they do little more than protect the eyes of the operator.

We tried several types of reflector,

(Continued on Page 111)

FILTERS AND 2-OHM VOICE COILS

The recent quantity release of Rola 120-X speakers has given rise to another batch of queries similar to that which followed the release of English twin-cone wide-range speakers. For the most part, the queries centre round distortion problems and the provision of filters to limit the frequency response on poor program sources..



A couple of typical auto - transformers which change the apparent 2-ohm voice coil impedance to 15 ohms—suitable for voice coil filters. The small transformer was hand - wound at practically no expense and is adequate for domestic listening requirements. The larger one is a manufacturer's prototype, with losses which are barely measurable.

THE letters in question all follow along the same lines and emphasise the possible difficulties of enthusiasts who are, for the first time, handling wide-range equipment — and particularly speaker equipment. They run something like this:

". . . since fitting the new speaker, the frequency range is obviously much wider and reproduction sounds very good on many programs. However, the high notes frequently have a rough, buzzing quality, which sounds just as if there was something loose in the speaker. However, I have checked the cone . . . &c."

AMPLIFIER TROUBLES

There is no doubt that, in a few cases, the troubles complained of may be traced back to the amplifier. arising from things like overload of an early stage, a faulty component or even supersonic oscillation. While such effects can be troublesome in any amplifier system, they are always rendered much more apparent when a wide range speaker system is employed, because the distortion components lie within the improved upper register.

Overload troubles should not occur in a properly designed amplifier but faulty components are always a possibility. Check plate and screen resistors, particularly for high resistance or open circuit and coupling condensers for leakage.

Precautions against supersonic instability include the use of grid "stopper" resistors (about 5000 ohm carbon), screen stoppers (100 ohm carbon) and the re-routing of long output plate leads. It is good practice to mount the output transformer on the amplifier chassis, grounding one voice coil lead and the frame of the speaker.

By and large, however, amplifier troubles appear to be very much in the minority and most of the complaints stem directly from the fact that a wide-range speaker makes plainly audible both frequencies and distortions in the signal itself which are not evident on a speaker with a less pretentious frequency response.

Both aspects are important. Even assuming that the input signal is perfect, the increased frequency range at the treble end may sound unfamiliar at first, after years of listening to traditional radio reproduction, and this may give rise to the suggestion that the tonal balance is all wrong.

Then again, wide-range sound is more demanding of attention and it simply cannot be relegated to the "background - to - everything - else" role that the classic "mellow" radio reproduction has occupied for so long.

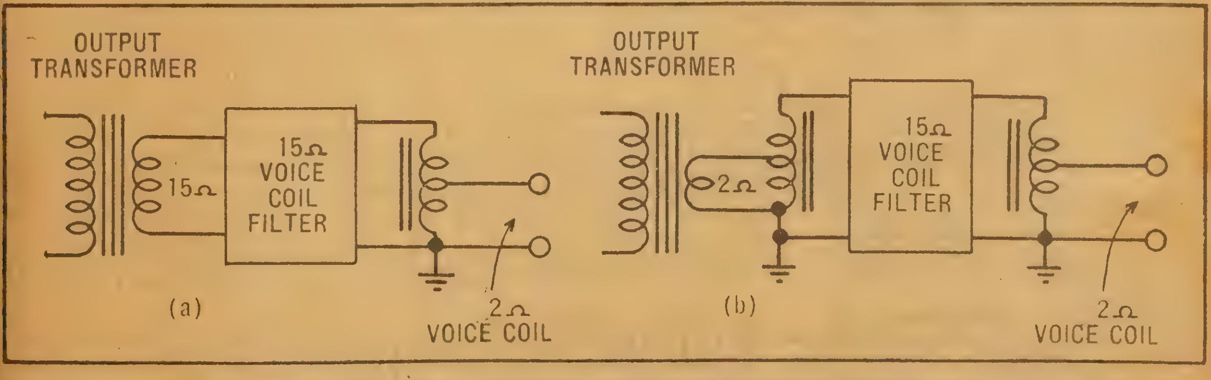
Wide-range sound must be heard in its own right and a revised approach is demanded of the listener

All this, of course, has been said before and it is likely to be repeated in substance at regular intervals. The reason is simple — each new group of high-fidelity "converts" must learn the same basic lesson that high fidelity has its peculiar difficulties as well as its rewards.

ACTUAL DISTORTION

Such musings, however, can not explain away consistent reports of actual harshness and "rattling" quality of the high notes. The explanation, rather, lies in the fact that many records and program sources do contain actual distortion in liberal quantities and this distortion is rendered painfully obvious by a speaker with an extended treble response.

Just how much of the distortion can be pinned down to the records themselves, or how much is introduced by ordinary pick-ups is open to considerable debate but the end result is the same—the input signal is distorted.



Preferred scheme is to fit your amplifier with a good quality 15-ohm output transformer, suitable for feeding a voice coil filter. It can then be coupled directly to an imported 15-ohm speaker or through the auto-transformer to a 2-ohm speaker. Circuit "B" is workable and can be tried out easily enough with two hand-made transformers.

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1379-1	200-20-30-40	350	200	5V-3A; 2 x 6.3V-2A	2	61/3
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967-1A	35	20	150	200	1000	12	50/-
986-22	15	10	300	60	1000	6	52/6
986-1	15	10	300	60	1000	7	62/6
986-1A	15	10	300	60	1000	21	57/6
1012-1A	35	20	100	430	1000	6	36/6

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TYPE AND MOUNTING No.	IMPEDANCE-OHMS PRIM.	SEC.	MAX. D.C. PER SIDE C.T.	MAX. D.C. UNBALANCE	MAX. D.B.M. LEVEL	APPLICATION		
705-6	30,000	600	6	0.5	+24	p.p. Triodes. 6J7's etc., to line	1	70/-
712-6	30,000	200	6	0.5	+24	p.p. Triodes. 6J7's etc., to line	10	70/-
710-6	20,000	600	—	6	+24	S.E. or p.p. 6J7's etc., to line	9	70/-
720-6	20,000	200	—	6	+24	S.E. or p.p. 6J7's etc., to line	10	70/-

AUDIO POWER OUTPUT TRANSFORMERS

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TYPE AND MOUNTING No.	IMPEDANCE-OHMS PRIM.	SECONDARY	WATTS	APPLICATION		
* 774-4	500	3.7: 2.3	5	LINE TO VOICE COIL	42	15/-
781-9	3-5000	250, 167, 125	15	PUSH PULL 2A3's/6A3's CLASS AB1 TO LINE	21	35/-
782-9	3-5000	8; 3.7; 2.3	15	TO VOICE COIL	9	35/-
786-9	10,000	250, 167, 125	10	PUSH PULL 6V6G's CLASS A TO LINE	9	55/-
790-9	8-12,000	500	14	PUSH PULL 6V6G's CLASS AB1 TO LINE	2	55/-
796-1	6,600	250, 167. 125, 100	34	PUSH PULL 807's CLASS AB1 TO LINE	9	72/6

DRIVER TRANSFORMERS FOR CLASS AB2 AND CLASS B AMPLIFIERS AND MODULATORS

TYPE AND MOUNTING No.	APPLICATION		
545-9	TRIODE DRIVER TO PUSHPULL AB2 GRIDS. P.A. RANGE.	12	55/-
570-9	5000 ohms P.P. TO class B GRIDS. rimary TO ½ secondary. Ratio 6, 5 or 4 to 1. V.F.	1	55/-
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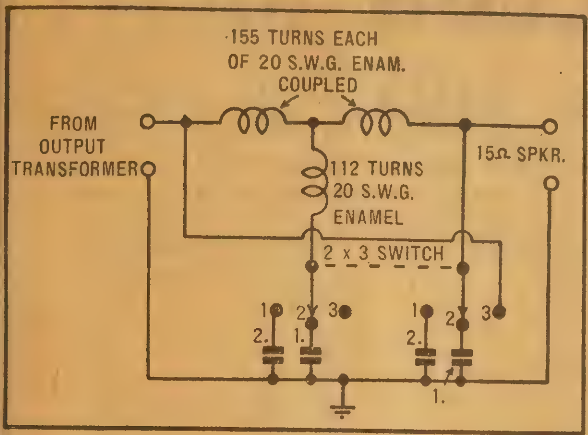
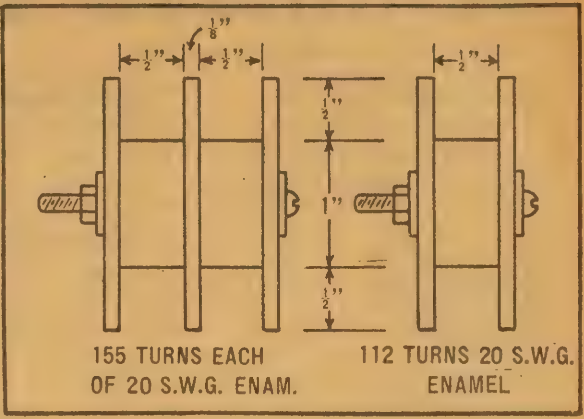
DETAILS OF V/C FILTER AND INDUCTOR BOBBINS



This circuit shows how the components are wired. The components' values are reasonably critical if the exact cut-off characteristics are to be maintained. The nominal cut-off frequencies are 6.5 kc for position 1 and 8.5 kc for position 2.



These dimension details should enable you to duplicate with reasonable accuracy the chokes used in the original unit. The original formers were made from scraps of broom handle and Masonite, but any similar materials may be used.

It has been claimed, too, that the "twin-cone" principle in a speaker is itself a compromise and that it gives rise to more peaks and intermodulation effects than do separate bass and treble speakers. This would, in turn, emphasise any distortion already present in the signal.

Once again, this may be an academic truth but the point of the matter is that dual speaker equipment is not available on the popular market locally, nor can standard speakers be associated easily to give the same overall response as one of the current twin-cone models.

And, arguments notwithstanding, it is certainly a fact that a twin-cone speaker can give extremely good reproduction when fed from a "clean" signal source.

WHAT TO EXPECT

The problem therefore boils down to something like this: (1) What can I expect from a wide-range speaker —in this case a 12-OX and (2) what can I do about possible distortion problems?

As it affects the listener, the application of a speaker like the 12-OX can be summed up under four headings.

(1) With an ordinary radio receiver. Some extension of the frequency range may be evident but the full value of the speaker will not be realised because the receiver itself greatly limits the treble response. For the same reason, no special distortion problems need be anticipated.

(2) With a TRF or other wide range receiver. Results with the wide-range speaker will be very pleasing for the most part. Some distortion will be evident occasionally on bad program material.

(3) With microgroove records and amplifier equipment. Most records will sound very good indeed and the speaker will generally show up at its best under these conditions. A few discs may be poor, especially near the centre, making you wish to do something about it.

(4) With conventional 78 rpm records and amplifier equipment. A few records will be good but, by and large, results will be disappointing. These are the circumstances which have given rise to so much misgiving about wide-range speakers, both local and imported.

Numerous tests have shown that there is only one certain cure where it is desired to play existing 78 rpm records—good, bad and indifferent—on a wide-range speaker and that is to include a filter in the system which will cut the freqency response quite sharply above about 6 to 8 kc.

Such filters are almost invariably of the tuned inductance-capacitance type, which have a sharp "turnover" characteristic. They are thus able to attentuate the regions of severe distortion without robbing the program any more than necessary of its still useful treble response.

Filters of this type are commonly used in broadcast stations in association with 78 rpm records.

Conventional resistance-capacitance filters are useful for de-emphasising microgroove characteristics, for controlling balance and so on, but their usefulness largely ends there.

Two basic inductance-capacitance filter designs have appeared in Radio and Hobbies, one intended for use with a special pre-amplifier stage and the other for direct connection into the voice coil circuit of a 15-ohm speaker.

The first type (see Radio and Hobbies for December, 1949) can be installed ahead of any amplifier, but it requires the addition of an extra stage and the appropriate connection to heater and high tension supplies.

Apart from the physical complication of adding a stage to an amplifier, there is always the chance that any such addition will produce motor-boating troubles, particularly in an already complicated circuit.

SIMPLER APPROACH

A voice coil filter system avoids this difficulty entirely, since it can be constructed as a separate unit and simply inserted in the voice coil line.

Objections to such a device, on the score of its reactive characteristics, are largely unreal because a loudspeaker is in any case a highly reactive device. Only on very rare occasions has the use of a voice coil filter been responsible for amplifier instability.

Two voice coil filters have actually been described, namely in the January, 1950, and June, 1952, issues. The first was a full-scale affair with four positions of cut as well as an out-of-circuit position. The later version employed cuts only at 6.5 and 8.5 Kc with a final out-of-circuit position. This is simpler to construct and adequate for most requirements. The circuit details are shown for the sake of reference.

In practice the filter can be switched "out-of-circuit" for most microgroove records and for good radio programs. Where the quality is poorish or where the radio program is suffering from heterodynes or "chatter," the 8.5 Kc cut can be used. The same position is handy for the best 78 rpm records but, for average 78 rpm listening, the 6.5 Kc position may be preferred.

These two filters appear largely to have solved the problem of enthusiasts who have bought the more expensive imported speakers with 15-ohm voice coils. They are not immediately suitable, however, for a speaker like the 12-OX because the degree of impedance mismatch is sufficient both to introduce marked ohmmic losses and to upset completely the filter's characteristics.

LARGE VALUES

The design of a filter for direct connection into a 2-ohm circuit is fraught with difficulties, however, because the lower working impedance demands very much larger values of capacitance and they are already formidable. The use of electrolytic condensers has been suggested but manufacturing tolerances on capacitance are rather loose and this may lead to very uncertain results.

In other words the position is certainly unpromising even if not completely hopeless.

There is, however, another relatively simple answer, namely in the use of an auto-transformer to change the effective impedance of the 12-OX to the higher and more convenient figure of 15 ohms. This makes it immediately possible to use the 12-OX with one of our standard voice coil filter circuits.

(Continued on Page 111)

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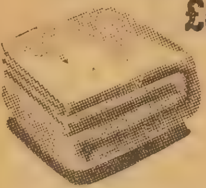

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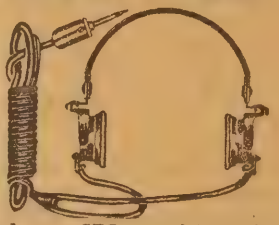

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DEITCH BROS.

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Almost Opposite Arnold's.

FROM THE SERVICEMAN WHO TELLS

(Continued from Page 41)

that the conductivity of this impurity had acted as a short across the turns of the coil, seriously reducing its efficiency.

Since a replacement coil was not likely to be available, there was nothing left but to wind a new primary winding on the existing former. This was not particularly difficult, but before fitting the actual winding I cleaned up all existing signs of corrosion and gave the former a liberal coating of coil dope. I reasoned that if the second winding lasted another 15 years the set would be due for a trade-in anyway.

The new winding not only restored the operation of the short-wave section, but also restored the missing gain and, when the alignment was complete, it put up an excellent performance.

SOME SATISFACTION

I must admit that jobs of this kind give me a certain amount of satisfaction, mainly, I suppose, because the performance of the finished set is such a vast improvement on what it was that one cannot help feeling that one's efforts have been worth while. The fact that the customer can appreciate the improvement is also gratifying, because servicemen, contrary to popular opinion, are really only human after all.

Well, nearly, anyway!

Perhaps it is for this reason that I shudder whenever I see a set in which the mains are not completely isolated from all possible points with which the user may come in contact or, indeed, where such isolation, though normally present, is only dependent on a single minor component for its maintainence.

A case in point was a mantel set which I recently serviced. The owner complained of severe electrical interference and fading, the signal strength varying with the opening or closing of light switches in various parts of the house, or at other times for no apparent reason. He also mentioned that, like the set in the well-known radio script, "it took a long time to warm up."

Because of the electrical interference problem I decided to examine the set in the owner's house. As I had expected there had been no attempt to provide an efficient aerial, this consisting of nothing more than a few feet of wire hanging from the back of the set.

AERIAL NOT NEEDED

When I raised this point with the owner he pointed out that the set was not supposed to need an aerial, being fitted, so the salesman had claimed, with its own "built-in" aerial. An inspection of the chassis soon revealed what was meant by a built-in aerial, for in addition to the normal short length of lead which came out the back of the chassis there was a lead running from the aerial connection of the coil to a blank pin on the power valve socket. From here, via what looked to be a very makeshift condenser, connection was made to one side of the power mains.

Quite apart from the doubtful efficiency of such an "aerial," schemes of this sort, in my opinion, constitute a very real hazard. Admittedly there is no danger while the coupling condenser remains intact, but the point is that this has only to break down to connect the aerial lead from the set to one side of the mains—and it is a 50-50 chance that it will be the live side.

What makes the situation even more dangerous is the fact that the aerial lead is normally regarded as harmless and is frequently handled without any precautions while the set is running. Maybe I'm the nervous type, but I consider that this is tempting fate too far.

As I said before, the scheme is not even justified on the grounds of efficiency. To be sure there is always a lot of signal to be picked up from the mains, but there is an awful lot of noise to be picked up there, too, and, in fact, such an arrangement provides about the worst possible signal-to-noise ratio. Furthermore, the strength of signal is by no means constant, varying as connections to the mains are varied, and this usually accounts for the fading in such cases.

I explained these points to the owner and pointed out that in order to provide any reasonable measure of relief it would be necessary to provide some form of outdoor aerial and to dispense with the so-called built-in aerial arrangement. He was quite agreeable to this, and I must admit that I was glad of an excuse to remove the potentially dangerous aerial-to-mains connection.

Quite apart from the safety angle, however, the changeover was fully justified, for even with a relatively inefficient outdoor aerial and a good direct earth connection the fading was virtually eliminated, while the electrical interference was only serious on two of the weaker stations, whereas before it had been objectionable on all stations.

SLOW WARM-UP

The slow warm-up characteristic was followed by a sudden start which suggested that the local oscillator circuit was to blame, apparently being sluggish in operation and not commencing to operate until some time after the remainder of the set was ready to go. By measuring the oscillator grid current while the set warmed up I was able to confirm this and then set about finding the cause.

One possibility in these cases is that the filament voltage is low, sometimes due to a dry joint at some point in the filament wiring. Alternatively the HT voltage may be low, the valve may have seen better days or may simply have developed this characteristic even though it tests good and would still have a normal expectation of life ahead of it. Certain continental valves were particularly prone to this trouble.

Having checked the valve, as well as all the voltages which could possibly effect this condition, I came to the conclusion that it was simply a characteristic of the valve (it was a continental type) and advised the owner accordingly.

Strangely enough, when he knew what was causing the trouble and was assured that it would do the set no harm he was not particularly worried and decided to get as much use as possible out of the valve.

Can't say as I blame him, prices being what they are. After all, I spent most of last Saturday afternoon repairing my windscreen wiper, rather than buy a new one.

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OFF THE RECORD — NEWS & REVIEWS

Having just returned from one of my periodical trips to Melbourne, during which I spent many hours yarning over radio and record matters, I can vouch for the keen interest of that city in high grade reproduction. Some trends are different, some equipment is different, but the old urge is there, and plenty of results are fine.

By JOHN MOYLE

IT makes me wonder just how large is the army of those who build amplifiers and argue about their virtues, for it's certain that in the other major cities of the land there is just as large a proportion of enthusiasts.

There is a fellowship, too among the clan, which knows no barriers of class or age. All one needs is to be really keen on getting good sound, and keen to listen to the music when it has been achieved, and one has qualified for universal membership. I have been buttonholed on street corners, in shops, in factories and in pleasant evenings in private homes, answering curly questions, and often picking up useful ideas and experiences to add to my own store.

I wonder how many other hobbies can give so much pleasure to their adherents as this matter of good reproduction?

And it's not only the man who can spend big money who is able to do well. I have heard some beautifully balanced outfits, using quite modest amplifiers similar to the small Playmasters, with a comparatively inexpensive speaker such as the Rola 120X which is now much easier t procure than formerly, and whic has proved to be the answer to man With modern microgroove record owners of such equipment are gettin results which only a few years ag would have staggered those able t buy the very biggest and be there is.

I'd say that Melbourne's fans, the representatves I met, are ju as much seized with this matter balance as against loud volume those in Sydney. Certainly, I hear at least one really big outfit whic was capable of both, but even he I'll wager the owner doesn't play nearly as loudly as he did when h had a lesser frequency range at h command.

Quite a few audio specialists see to be arising, too, who are buildi high grade equipment for their ow selective public, just as in Sydney. heard the same names cropping u over and over again, as the pro ducers of some particularly admire amplifier. In one of the maj stores, I saw an elaborate radiogra chassis costing £100 which apparent held a high reputation among tho who could go to that amount.

WIDE RANGE TUNER

I also took with me one of th Playmaster equipments comple with our latest wide-range tuner, a the reception it received convince me without any doubt that it's ju the thing many people have be waiting for. I don't think anyo heard it who is not now collecti the parts to build it up. Like ou selves, they had been compromi ing with a TRF tuner, and doi quite well, but found in the new j just that extra amount of top, a greatly improved selectivity, whi made all the difference.

It looks as though the "custo built" idea is bound to grow fro now on, particularly when bett records are easier to get and mo people begin to appreciate the It warms the proverbial cockles the heart to see so many at l getting within earshot of reprodu- tion of the type they have dream about in the past.

Not that any of their dreams e really come true. Somebody son how always seems to go a lit further. But isn't it always ? Our achievements in hobbies or everyday activities are always st ping stones to bigger and bet things.

TAX REDUCTION

The amplifier fan, in common wh the radio set-builder and music lo will welcome the sales tax reduct to 20 pc as some relief at least fr the high cost of things in gene

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"Q PLUS" OSCILLATOR

This very small 455 kc oscillator is a boon not only to the serviceman, but also the radio enthusiast. Now you can do the job of alignment in a workmanlike manner.

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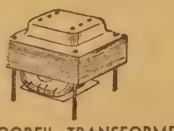

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40 m/A.	6.3v,		240v	43/3
40 m/A.	6.3v,	5v	240v	45/6
40 m/A.	6.3v,	5v	275v	46/10
			385v	52/10
60 m/A.	6.3v,	5v	275v	54/-
60 m/A.	6.3v,	5v	385v	63/7
80 m/A.	6.3v,	5v	275v	64/10
80 m/A.	6.3v,	5v	385v	75/7

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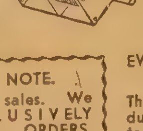

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At present, the reduction is not enerally available because it will e necessary first to clear out stocks f records and materials in respect f which the higher tax has already een paid. This point will probably e indicated by a universal price eduction in records produced by ajor companies at a given date, ut at present no one seems to know ust when this will be. To some exent it will depend on how soon resent stocks are used up.

Personally, I think the tax is still oo high by at least 5 pc in any eckoning, although I did not expect t to drop lower than 25 pc. I'm fraid there were plenty who feared t would not drop at all!

There is no more authoritative news oncerning the release of microroove records made by the EMI roup, apart from the anticipation hat there will be some records in ime for the Christmas trade. Nor is here any indication as to whether ny preference will be shown for ne speed more than another. In y view, there is nothing likely to hange the probability that all speeds will be used, which means perhaps 45 pm records appearing for the first ime in steady numbers. The comany may have to make up its mind whether to use its stocks of disc aterial for long players for a start, eaving popular numbers as now on he 78 presses.

LP RECORDS

I think that 33 LP records would e the best bet at the time release is lanned. The supply of overseas ecca records is now very low, and here is bound to be a big demand or fresh supply from EMI. The ingle number and popular stuff ould, for the time, be just as aceptable on 78.

Will EMI follow the example of ther companies, and include LP ubbings from 78 records already reeased? I think it quite certain hat in some cases it will. Some f the longer works on 78 released ecently have been of a very high erformance and quality, and unoubtedly cost a good deal of money o produce. If the performance is ood, why shouldn't the company xtend sales to the limit be re-issuing ith the benefit of long playing? 'm thinking particularly of recordngs such as Lipatti's Schumann Conerto. The only real criticism one an make of this at present is the requent breaks to change sides. Its ale on LP discs I'm sure would be errific.

E-ISSUES

But I sincerely hope that only ighlights of this type will be used nstead of new material. Surely MI will not make the mistake, too requently perpetrated by other reording companies, of redubbing aterial unworthy of the compliment. his should not happen, as we may ssume that the last twelve months r so have been profitably used in uilding up an adequate bank of ighgrade tapes. And, of course, ictor's catalogue is there to be used.

How such obstacles as import retrictions, &c., will prevent the local MI from doing all they would like do is probably known only to emselves. But I, for one, am execting big things.

There are, too, other companies inerested in the record business whose lans must be getting under way now. At the moment, it's almost pure guess work to forecast when we'll see much of them.

Reading through an overseas magazine recently, I came upon a point which has often been brought to my notice, and which apparently pops up elsewhere. It is the idea some people seem to have that the latest high grade recordings, particularly microgroove, only sound good on good machines.

This is only a half-truth, and it's important to keep the facts in mind, even though I have included most of the relevant points from time to time during the discussion of other matters.

GOOD 78's

In the case of 78 records, which are not recorded with pre-emphasis or boosted high notes, I'd say that the average radiogram would play them as well, if not better, than poorer records. They are generally cleaner, quieter, and have better "presence"—they sound more lifelike. There is no mystery about them which sets them apart from the general catalogue. It's true that some are cut rather heavily in loud passages, and might not wear well, except with a modern lightweight pickup, but it's assumed that the old rock-crushers of bygone years aren't seriously considered today for serious work.

LP records are not quite the same, however, because they have a pronounced pre-emphasis in the top region, which should be compensated for by de-emphasis in playback by the same amount.

In most cases, this de-emphasis can be achieved simply by playing the records with the tone control turned almost right on. This gives that gradual and severe reduction in highs which is brought about by the normal compensation circuit.

The average speaker found in an ordinary radiogram will provide a more or less top cut anyhow, to assist the process.

AND MICROGROOVES

So that, in general terms, even microgroove records can be made to sound quite well on a good average machine by the exercise of a little intelligence. It is, I hope, unnecessary to point out that a special microgroove head must be used with such records.

We mustn't get carried away by our super gramophones to the extent that we rule out altogether results obtained by less fortunate enthusiasts. It is true that only on really good gear can we hear all there is to be heard from good records. Not-so-good equipment won't realise the full frequency range, might exhibit some peaks we'd rather not have, and throw lots of good music down the sink. But it needn't sound any worse than it does on older records, and in pretty well every case it can sound a darn sight better.

I've had to illustrate lectures on amplifiers with a makeshift arrangement, using very ordinary pick-ups and speakers by high-grade standards. I've been pleasantly surprised just how pleasant the result has been, and the audience reaction confirmed, if this were necessary, that the average listener can certainly appreciate the better reproduction the latest records can give with modest gear.

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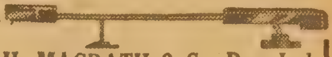

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THE HAM BANDS WITH BILL MOORE

There are now well over 100,000 Radio Amateurs licenced in the USA and they comprise the majority of the world's amateur stations. Changes in their regulations do affect operating conditions in other countries.

AS reported in recent months, amateur stations in America have been receiving plenty of attention in the regulatory field and the FCC have been presenting new proposals at a rapid rate. Each series of proposed new rules are called a "docket," and individual amateurs or organisations are invited to comment on the proposals before final decisions are reached.

Any variations in sub-allocations in the HF bands for 100,000 American stations can quite easily affect operating in other countries. Just at the moment conditions are unfavorable and here in Australia even an extension of the telephony allocation on 14Mc would only affect us a few hours a day. When the sunspot maximum is to hand, however, from past experience we know that only a few of the outstanding VK signals could safely venture into their telephony allocation. No change is suggested for 14Mc, but the proposed 21Mc sub-allocation for telephony could write off a great portion of that band for many hours a day.

Four dockets are current, and briefly they cover the following points — First: Specific proposals to allow telephoney on 7200 to 7300 Kc/s, novice operation 7175 to 7200 Kc/s, FSK radioteletype on the CW sections of 20, 40 and 80 metre bands. Second: Proposals to open 20 and 75 metre telephony allocations to all classes of licensees except novice and technical. Third concerns local power regulations on the 160 metre band. Fourth: Sub-allocations in the 21 Mc band.

DO AFFECT US

It is the latter proposal that can affect us here. Possibly local US regulatory matters are no concern of ours, but in the past the ARRL board have always considered sub-allocations on a broad basis. This was to ensure that the world's amateurs could make the most effective use of any HF band.

The FCC in their 21 Mc band proposal oppose the usual arrangement for our HF bands by suggesting a telephony allocation at the low frequency end of the band —21,000-21,100 Kc/s. Full division is as follows: 21,000-21,450 Kc/s—CW, 21,100-21,350 Kc/s—FSK teletype, 21,000-21,100 and 21,350-21,450 Kc/s—telephony, 21,150-21,300 Kc/s—novices. Throughout the years the low frequency end of the bands have been left for CW operation, mainly to keep different sections in harmonic relationship, which was a help when crystals were in use. Today with VFOs there is no great problem.

The division of the band in this manner does, however, complicate matters for CW operators. It would be hard to define where their section would commence and finish. If you add the two 100 Kc American telephony allocations to a 50 Kc allocation for Canadian telephony stations, plus two 75 Kc foreign phone segments, one beside each American segment, the CW gang ends up with about 50 Kc/s somewhere in the novices' allocation. It is apparent that the FCC have considered the allocations from a domestic viewpoint and not thought of its impact on international communication.

SPECIFIC REQUESTS

At a subsequent ARRL board meeting when the above dockets were discussed directors decided to make the following requests of the FCC: Open 7200-7300 Kc/s and 21,250 to 21,450 Kc/s for telephony operation (the latter allocation in accordance with the band planning recommendation of the International Amateur Radio Union formulated in Paris in 1950); extend the 10 metre telephony band down to 28,250 Kc/s (now 28,500 Kc/s); open 3775-3800 Kc/s for mobile telephony operation, and recommend that the 75 and 20 metre telephony allocations be open to holders of the higher classes of licences only; allow novice operation 7150-7200 Kc/s and 51-53 Mc/s (latter for one year only); open 7150-7200 Kc/s for FSK teletype, and permit duplex operation 51-54 Mc/s.

The majority of the above proposals cannot affect us, as they concern the 7150-7300 Kc/s portion of the 7 Mc band, which it not available to Australian amateurs.

The 21 Mc proposal is in accord with general opinion. The extension of the 28 Mc telephony allocation may force foreign phone stations toward the low frequency end of the band. CW operation on 28 Mc is limited except during contests, and 30 Kc/s or so should accommodate CW stations active.

MORE CERTIFICATES TO BE ISSUED

The editors of the Short Wave Magazine have decided to issue a number of DX certificates for varied operating achievements. The virtues of magazines issuing DX certificates are debatable; it should be the prerogative of national amateur radio societies, who are in a better position to judge the requirements in such a field. We must nearly have enough of these certificates, and the general policy of societies in recent years has been to keep the production of new issues to a minimum.

To give some idea of the number of certificates available the following is W2QHH's tally: AAA, EDXC, WAA, WAC/YL, WAS/YL, WPR (200), WASM, WFJS, BERTA, BPL, CP/35, DUF-4, DXCC, FOC, KZ5-50, ORS, RCC, WAE, WACD, WACE, WAP, WAVE, WBE, WMM, WNEV, WRAMEY—26 in all. The total available for operating effort is somewhere in the region of 50 to 60.

The four new awards to be issued by the magazine are: (1) Four-band award—available to amateurs who can produce confirmation of contacts with at least 20 different countries, each of which must have been worked on four different bands. Postwar contacts only will count, and the award should be a very difficult one to qualify for. (2) WNACA (worked all North American call areas)—confirmations required from all Ws 1 to O, nine VE districts (VE8 divided into two Yukon and North-west Territories), KL7 and two VOs (Labrador and Newfoundland). (3) WABC (worked all British counties). Proof is required for contacts with 60 counties on the 160 metre band. (4) WFE (worked Far East). This certificate will be a difficult award to win, even for Australian stations. You must produce confirmations from 18 of the following 23 prefixes: C, C3, CR9, C9 (MX), CRIO, DU, FI, HL, HS, JA, KR6, PK1-2-3, PK4, PK5, PK6 (Moluccas only), UAQ, VS1, VS2, VS4, VS5 (Brunei), VS5 (Sarawak), VS6, XZ.

All the awards are for postwar contacts only, but for the WABC only contacts from January 1, 1952, will count.

All claims together with cards and check list should be addressed to "DX Commentary," Short Wave Magazine, 55 Victoria St., London, SW1.

AMATEURS ACTIVE AGAIN IN FLOODS

Late in July, when the Macquarie Riv floods reached serious proportions Bathurst, the 144 Mc band was used for emergency call to Sydney. It was the fi time that the UHFs have been used f emergency working and as the distan covered was 100 miles it was even mo interesting.

At the time, the Bathurst-Sydney tel phone link was out and the Bathu police requested Trevor Evans, VK2N to contact Sydney with an urgent messa for the dispatch of Army "ducks" i mediately to the area. A number people were isolated and lives threatene A CQ Sydney emergency on 144 Mc 2000 hours resulted in a reply from Char Fryar, VK2NP, who relayed the messa to the Sydney police. The link was ke open until 0100 hours and other messag handled. Trevor for some months n has been putting a consistent signal i Sydney over the Blue Mountains, so Mc recorded its full-scale emergen effort.

Further work in the emergency fie was performed on August 6 and 7 wh the Hunter branch emergency net swu into operation after a cyclonic disturba caused river levels of the Hunter and tributaries to rise swiftly. Although pe levels during the flood were the same in the devastating 1949 floods, river ban held and the town of Maitland was sav from serious flooding.

At 1 pm on July 6 Alec Mathers, VK2J who was at B/c station 2HR at Lochinv decided to proceed back to Singleton a establish contact with 2HR as river lev were rising rapidly and detailed inform tion was not available. Alec was forc to leave his car five miles from the tow but completed the journey and came 3.5 Mc at 5 pm. Bob Best, VK2TY, at t transmitter site made contact with him.

ALL MAIN TOWNS

Other stations in the area were so operating, and all main towns along t Hunter were covered. Stations that op ated in the net were Ken Mitchelh VK2ANU, Muswellbrook; Geoff Partrid VK2VU, and Alec Mathers, VK2JZ, Singleton; Bob Best, VK2TY, of Lochinv Keith Rudkin, VK2DG, and John Tra VK2XQ, of West Maitland; Vic Holm VK2AKP, East Maitland; Jack H VK2ADT, Cessnock; and Harold Why VK2AHA, Newcastle. The net operat continuously for 24 hours from 5 pm We nesday to 5 pm Thursday, and VK2 acted as control station. Bob routed messages via telephone to flood hea quarters at Maitland. VK2JZ provid official height recordings from Mr. De Town Clerk at Singleton, to Mr. Dunkl Town Clerk at Maitland. It was m important that levels from up-river sho be available at Maitland, so they co estimate likely levels to be recorded th and also so they would be able to dec when the peak was to occur.

VK2ANU provided the levels from upper reaches. Heights supplied were a broadcast from 2HR. The net clo officially after headquarters decided lev were no longer required.

Mrs. Best acted as assistant at VK2 running the telephone link and was re operator while Bob slept for a few ho VK2WH, VK2ACC and VK2ZN cleared net frequency on a number of occasi and 2HR broadcast appeals to amateurs operate in the net. VK2XQ joined net at 1 am after a trip from Newcas while VK2VU, who had no 3.5 Mc tra mitter at 5 pm, was operating a two-st affair at 8 pm after a rapid building p gram.

As on many occasions during the p few years the Hunter net was again to assist the authorities.

TEMS OF INTEREST FROM THE W.I.A.

HE NSW Division of the WIA have
set out to improve information avail-
le to amateurs on conospheric pre-
tions for their bands. Angus Robert-
n, VK21Q, who lectured recently at a
isional meeting on "Ionospheric Pre-
tions," is co-operating, and Councillor
l Nye, VK2XU, has been appointed
-ordinator.

t is hoped to provide in the middle
the month, via the Bulletin and VK2W1,
detailed report on predictions for each
nd. If amateurs co-operate and provide
ports on the accuracy of the predic-
ns, it will assist those preparing the
ta. Any information of an unusual
ture will be supplied to the authorities
oviding the monthly charts in Amateur
dio. They co-operate with us, and
ports will be appreciated to VK2XU,
Box 1734. GPO, Sydney.

wo field days will be conducted shortly
NSW. The first will be run by the
nter branch of the WIA, on Septem-
28, at Blackall's Park, Lake Mac-
arie. It will be a combined field day
d social meeting, and special atten-
n will be paid to the requirements
YL's, XYL's and kiddies. The radio
tion will include a 144 mc Hidden
ansmitter Search, with unusual in-
vations.

L WELCOME

An open invitation is issued to all
ateurs and their families to attend.
ease let branch secretary, Varley Fitton,
2SF, of your intentions; he can be
ched at Box 13, Newcastle, 34 Faw-
t St., Mayfield, or by telephone at
wcastle B1874 during business hours.

he second field day will be run a
ek later over the Six-Hour Day holi-
y weekend. It will be on 144 mc. and
combined effort of the NSW WIA
IF section and the Gladesville Radio
ub. Stations will be located at many
h spots throughout the State.

tations will be active on all three
ys, October 4, 5 and 6, but as many
rties will be travelling many hun-
eds of miles, the main day will be
Sunday. A prize of £5 will be divided
ween the two stations in the State
vering the greatest distance; a cup
d other prizes will also be awarded.

t is hoped to obtain co-operation from
mc. stations in other States. Full
ails of the stations, and the locations
m which they will be transmitting, will
given over VK2WI.

he NSW UHF section's 50 Mc scramble
s conducted for an hour on August
and was well supported. 22 stations
the Sydney and Newcastle areas par-
ipated. Vaughan Wilson, VK2VW, and
n Miller, VK2ANF, tied for first place,
rking 17 of the 22 stations. Bill Mac-
wan, VK2MQ, was in second place with
contacts. A feature of the contest
re the arrangements made for the
nouncing of leading participants. At
conclusion of the scramble, stations
rticipating were called by VK2WI,
o analysed the scores given and im-
diately nominated the winners — a change from the normal wait for results.

Dr. Bob Black, VK2QZ, lectured at the July meeting of the NSW Division on his radio and other experiences on a trip through the islands. Bob operated a type III—Mark II under VK2QZ/P, VKG and VR4AF callsigns. He was assisted by Dr. Holt. It was very interesting and Dr. Balthasar, VK2IH, provided some diversion by asking a number of medical questions. General business included a decision to set up the organisation for a 144 mc. emergency net in the State, and a list was made of the various types of lectures to be provided in the future.

The position of class supervisor of the NSW Division's AOCP class is vacant. Allan Appleby, VK2BF, who has been supervisor for a number of years, was forced to resign for business reasons. The State secretary, Dave Duff, VK2EO, would be pleased to supply details of the vacancy to anyone interested. Classes are held two evenings per week.

THE UHFs

Another link was made in the western NSW 144 mc. network when VK2ACT, Bill Brooks, of Dubbo, and VK2WH, Hugo Stitt, of Forbes, contacted for the first time on July 13. S7 signals were exchanged over the 80-mile path; and contacts have been made subsequently on a number of occasions. Eill is now trying to bridge the 180 miles to Sydney.

Quite a number of New Zealand stations have been trying to bridge the Tasman on 144 mc. Details of stations operating are as follows: ZL2ACB, 100 watts, 12 element phased array, operating on 144.1 mc/s—ZL2SM, 20 watts, 16 element array, operates on 145.6 mc/s—ZL2GL, 90 watts, 12 element phased array, operates on 144.9 mc/s—ZL2MV, details of equipment not known.

Although most of UHF gang are not too optimistic about New Zealand stations breaking through at this time of year but have been listening out.

A number of European stations have sizable country lists on 144 mc/s. G3BLP has worked 12 countries on band covering DL, EI, F, G, GC, GD, GI, GM, GW, ON, OZ, PA. G5YV is one country behind with a tally of 11

DX & PERSONAL

ZS2MI, Marion Island, broke through on a dead band on a couple of occasions at 2000 hrs. east, frequency 14050. Some of the VK6 gang have contacted ZS6ZU, who is also on the island. He has been operating on telephony toward 14350 kc/s.

DX has been fair during the late mornings on 14 mc, mainly Europeans, but AC3YM, 14050 kc/s, has been heard at 0930 hrs.

The Brazilian 21 mc. contest created considerable interest, and PY stations were making many contacts. During the first weekend of the CW section, PY2CK worked over 100 different stations, mainly W's on 21 mc. The LABRE the Brazilian Society would be pleased to receive reports on PY signals during the contest.

TV FOR INSTRUMENT LANDINGS

LL landings at the Washington
National Airport are being tele-
ed as a safety measure.

3. C. Haynes, head of the Weather
reau's Meteorological Observations
tion, said in an interview, that
elevision camera at the end of the
in runway gives control tower
erators a "pilot's eye" view dur-
landings.

The camera lets control tower men
approximately the same clouds,
sps of fog, and runway puddles the
ot sees, which should make bad
ather landings much safer.

Preliminary tests here indicate
evision should have widespread
plication at such airports as Chic-
and Los Angeles.

The Weather Bureau tests are being conducted in conjunction with the Air Navigation Development Board as the first phase of a long-range study of television for flight safety.

Telecasts of the landings are being made by the Allen B. DuMont Laboratories, Inc., under a 10,000 dollar contract.

The camera covers the "instrument" runway, which all planes use in bad weather for Washington landings.

The end of the runway, where plane wheels first touch the ground, is right on the bank of the Potomac River and more than 3000ft from the control tower. Because of this, Haynes said, tower men frequently cannot see the clouds and fog which may obstruct a pilot's view.

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10	5000, 2500 SE	5, 2.7	71/-		OP-33
10	5500 SE	3.7	78/4		OP-41
10	30,000 20,000 14,000 10,000, 7000, 5000, 2500 PP	2.3	70/10	Universal Test Loud Speaker	OP-53
10	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	78/4		OP-54
10	5000, 2500 SE	15.	71/-		OP-39
10	10,000 PP	15, 8.4, 2.3.	78/4	5W Cath Amplifier	OP-85
10	7000 PP	Any ONE of following impedances—15, 12.5, 8.4, 2.3, 2.	78/4	9W Cath Amplifier	OP-92
15	5000 PP	12.5, 8, 2.3.	107/8		OP-2
15	6600 PP	12.5, 8, 2.3.	107/8		OP-3
15	10,000 PP	12.5, 8, 2.3.	107/8		OP-4
15	10,000, 6600, 5000 PP	12.5, 8, 2.3.	107/8		OP-5
15	5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	114/9		OP-55
15	6600 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	114/9		OP-56
15	10,000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	114/9		OP-57
16	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	116/-		OP-58
25	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	145/5		OP-59
32	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	185/10		OP-60
60	3800 PP	17.6	181/2		OP-36
60	3800 PP	100, 75, 50, 25, 10, 5, 2.	212/5		OP-61

P.A. RANGE 50-8000 cps. Output to Line

10	5000, 2500 SE	500	69/10		OP1A
10	5000, 2500 SE	500, 250, 125	80/9		OP-44
15	5000 PP	500, 250, 125	107/8		OP-6
15	6600 PP	500, 250, 125	107/8		OP-7
15	1000 PP	500, 250, 125	107/8		OP-8
15	10,000 PP	500, 250, 160, 125, 100, 83.5, 71.5, 62.5, 55.5, 50	127/6		OP-8M
15	10,000, 6600, 5000 PP	500, 250, 125	107/8		OP-9
15	5000 PP	600, 300, 200, 150, 130, 100, 75, 50	124/11		OP-34
15	8000 PP	600, 300, 120, 60, 30	217/3		OP-50
25	5000 PP	500, 250, 125	130/-		OP-10
25	6600 PP	500, 250, 125	130/-		OP-11
25	10,000 PP	500, 250, 125	130/-		OP-12

P.A. RANGE Cont.

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
25	10,000, 6600, 5000 PP	500, 250, 125	130/-		OP-13
25	10,000 6600 PP	500, 4000, 8.4, 2.2	178/4	Cutting and Playback Amplifier	OP-35
25	6600 PP	600, 300, 250, 200, 170, 150, 76, 50, 36, 27, 12.5, 7.5,3.6,2.7	217/3		OP-38
32	5000 PP	500, 250, 125	157/6		OP-14
32	6600 PP	500, 250, 125	157/6		OP-15
32	6600 PP	500, 250, 166, 125, 100, 83. 5,71.5, 62.5, 55.5, 50	161/8		OP-15M
32	10,000 PP	500, 250, 125	157/6		OP-16
32	10,000, 6600, 5000 PP	500, 250, 125	157/6		OP-17
32	6600 PP	140, 70	185/10		OP-48
60	3800 PP	500, 250, 125	183/4		OP-18
60	3800 PP	100, 75, 50, 10, 5, 2	212/5		OP-61
80	6400 PP	500, 250, 125	225/-		OP-37
105	8800,6000 PP	500	325/-		OP-49
150	11,600 8400 PP	500, 250, 166, 125	417/6		OP-20

HI-FI RANGE 30-15000 cps. Output to Voice Coil

5	5000 SE	Any ONE of the following impedances 15, 12.5, 8.4, 6.5, 2.1	73/4	4W Baby Playmaster	OP-24
10	3250 SE	12.5, 8.4, 2.3	110/-	R & H Vox Major	OP-23
10	5000 SE	2	100/-	For Rola 120x Speaker	OP-113
10	5000 PP	2	100/-	For Rola 120x Speaker	OP-117
10	6600 PP	2	100/-	For Rola 120x Speaker	OP-119
10	8000 PP	2	100/-	For Rola 120x Speaker	OP-118
10	10,000 PP	2	100/-	For Rola 120x Speaker	OP-112
15	5000 PP	12.5, 8, 2.3	160/-		OP-19A
15	10,000 PP	15, 3.75	166/3	10W Playmaster	OP-63
15	10,000 PP	12.5, 3.125	166/3		OP-64
15	10,000 PP	8.4, 2.1	166/3		OP-65
20	4500 PP	15.5, 12.5, 8.6, 2.7, 2	146/-	15 & 32W Cathamplifiers	OP-51

Output to line

10	3250 SE	500, 250, 125	110/-		OP-22
15	5000 PP	500, 250, 125	160/-		OP-19B
15	10,000 PP	500, 125	166/3		OP-62

SPECIAL HI-FI RANGE 20-30,000 cps.

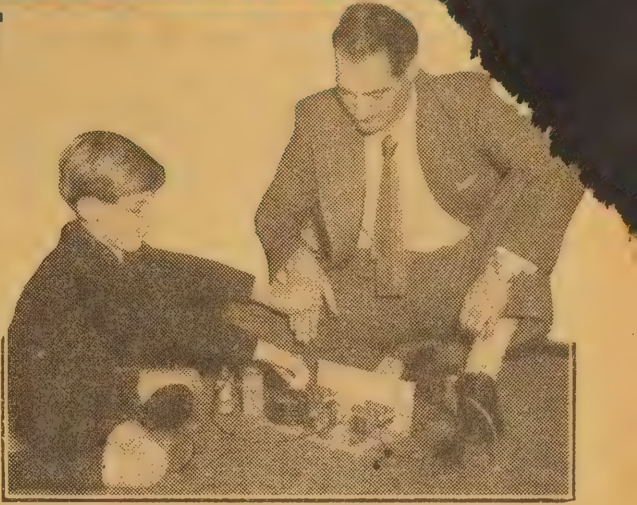
15	10,000 PP	8.4, 2.1	196/8	For Williamson Amp.	OP25/8.4
15	10,000 PP	10, 2.5	196/8	For Williamson Amp.	OP25/10
15	10,000 PP	12, 3	196/8	For Williamson Amp.	OP25/12
15	10,000 PP	15, 3.75	196/8	For Williamson Amp.	OP25/15
15	10,000 PP	16, 4	196/8	For Williamson Amp	OP25/16
15	10,000 PP	40, 10	196/8	For Williamson Amp.	OP25/40
15	10,000 PP	250, 62.5	196/8	For Williamson Amp.	OP25/250
15	10,000 PP	500, 125	196/8	For Williamson Amp.	OP25/500
15	5000 PP	8.4, 2.1	209/2		OP-66
15	5000 PP	15, 3.75	209/2		OP-67

ENGINEERED **TO-DAY** FOR **TO-MORROW'S** REQUIREMENTS

TRADE REVIEWS AND RELE

A.W.A. RELEASES HOBBY KIT

An excellent means of introducing the radio hobby to the younger generation, in a safe and practical way, is provided by the G. Marconi Experimental Radio-Kit recently released by AWA. This has been designed to reduce the building of a radio to its simplest possible terms, the only tools required being a screw driver and a piece of sandpaper.



HE complete kit of parts, neatly boxed, provides all the parts nec- sary to make a simple one valve which is, nevertheless, ext- emely efficient and, as well as pro- ding much amusement and in- uction during the actual building, ll provide many hours of enter- nment when completed.

In this regard it makes a very in- pensive second set which will allow e younger members of the house- ld to select their favorite programs thout disturbing the adult enter- nment.

In any home construction project this kind, it is very important that possibilities of electric shock are minated and that the actual ethod of construction be such that absolute minimum of skill and perience is required to complete

Both these problems have been overcome in this kit, since it is a battery operated receiver, and the skilful use of spring clips and terminals has eliminated the need for soldered joints. Thus the improved performance of the valve receiver is retained together with the safety and simplicity of the crystal set. The makers claim that it is suitable for children of seven years of age onward.

Retail price of the complete kit, including batteries, is £6/6/-, and adequate stocks are at present available.

QUALITY MULTIMETER FROM PATON

ATEST release from Paton Elec- trical Pty. Ltd. is a high grade rtable multimeter designated as odel M52.

This instrument is intended for e by the advanced serviceman, oratory engineer, or sound tech-

chian and has a wide selection of ry useful ranges. These number in all and include AC and DC ltage and current, resistance and cibels. Sensitivity is 1000 ohms r volt on all ranges.

The current ranges extend to 30 nps, both AC and DC, while there e two db ranges, one based on a ro reference level of one milliwatt in 600 ohms and the other on 6 milliwatts into 600 ohms.

The meter scale is printed in three colors and this assists materially in selecting the current range. In addition to the basic ranges an extra set of ranges, known as the red ranges, is provided by operating a press button. The red ranges are 1/3 of the basic ranges, making possible very close readings on all values.

A very valuable additional feature is an automatic cut out designed to protect the meter movement in the event of accidental overload. This is set to operate at between 8 and 10 mA, an overload which the meter movement has been designed to stand without damage.

AEGIS RELEASE WIDE-BAND KIT

AEGIS MANUFACTURING CO. PTY. LTD. advise that they are making available a kit of coils to suit the wide range tuner described in the August issue of Radio and Hobbies.

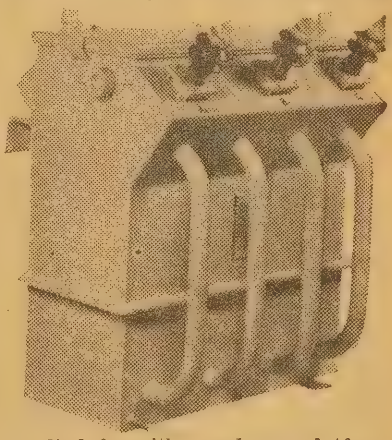
The complete kit, in one package, comprises the special aerial, bandpass, and oscillator coils, two 1900Kc IF transformers, and the whistle filter coil assembly.

Assembled into the original Radio and Hobbies circuit, this kit should make an excellent tuner and no trouble should be experienced in duplicating the first class results obtained with the original model.

FERGUSON 50KV TRANSFORMER

LATEST of the distribution transformer range released by Ferguson Transformers Pty. Ltd. is the 50 KVA type shown in the photograph.

This is a three-phase oil immersed type with low voltage tappings of 415 and 240 volts, and high voltage tappings of 11,000, 10,750, 10,500, 10,250 and 10,000 volts. It can be



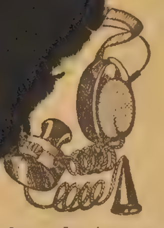
supplied for either pole or platform mounting and is available for early delivery.

Other three-phase transformers available are 10, 15 and 25 KVA, with similar characteristics to the 50 KVA except that they are for pole mounting only. The single phase range includes 5, 10 and 15 KVA, with 480 and 240 LV side and HV side similar to the three-phase.

JOHN MARTIN PTY. LTD.

JOHN MARTIN PTY. LTD. wish to advise that Mr. W. H. North, who has been their manager for some years, has tendered his resignation and that, pending a permanent appointment to this position, Mr. C. J. Briscoe, an executive from Head Office in Brisbane, has been appointed acting manager.

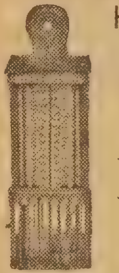
EAD MIKE



able for short-wave en-
usiasts. For No. 11, No. 22 sets, etc. In first-class condition.
Price, per set **19/6**
Packing and Postage: Vic. 4/6, N.S.W., S.A., Tas. 6/-, Q'land., W.A. 7/6.

1 meg. CRYSTALS

Suitable for Crystal Calibrators **£2**
Postage & Packing: Vic. 3/6, N.S.W., S.A., Tas. 4/-, Q'land 4/6.



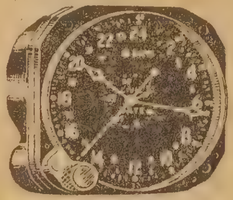
HYGROMETER
WITH CHART

For Temperature and Humidity Reading.

Suitable for
- ★ **Factory**
- ★ **Home**
- ★ **Dairy**

An accurate and high-class instrument having two thermometers with calibrated Fahrenheit reading scales.
PRICE **19/6**
Postage: Vic., 4/-, N.S.W., S.A., Tas. 5/6, Q'land., W.A. 6/6.

WALTHAM 8-DAY



CLOCKS
IDEAL FOR CARS AND TRUCKS

Precision built in America by the famous Waltham Clock Co. for the US Navy and containing the highest quality movements. Special features include: 24 hours dial, sweep second hand, tells civil date, handy size (3½in dial), and chronometer-like accuracy.
OUR PRICE .. **£9/10/-**
Reg. Postage & Packing: Vic. 4/6, N.S.W., S.A., Tas. 5/9, Q'land., W.A. 6/3.

HAND BEARING COMPASS

A beautiful and extremely accurate instrument, liquid damped, Adjustable reading prism complete with torch handle for standard battery; illuminates card for night use. Packed in transit carrying case.
Easily worth three times the price **£7/10/-**
Packing & Postage: Vic. 5/-, N.S.W., S.A., Tas. 7/-, Q'land., W.A. 8/6.

DISPOSALS!

PRISMATIC TELESCOPIC SIGHTS

Can be converted for use as rifle sight, surveyors' sighting telescope and many other uses where first-class lenses are required. Length 5½in. Eye-piece lens 1in, front lens ¾in, eye relief 3in. Weight 15oz. **£3/10/-**
Packing & Regd. Postage: Vic. 5/-; N.S.W., S.A., Tas. 6/3; Q'land., W.A. 7/-

MAKE YOUR OWN FISHING ROD

With this Tank Whip Aerial the handyman can make a flexible fishing rod equal to the expensive type used by keen amateur fishermen. Comprising two 4ft tapered tubular sections of tempered spring steel, fitting snugly into each other, it is a simple matter to construct a first-class rod. Weight 6oz.
PRICE **15/-**
Plus 5/- freight. Despatched by quickest route.

BUILD YOUR OWN DUMPY LEVEL

The "ASTRO COMPASS" can, with slight modification, be made into an accurate dumpy level. Additional requirements a light tripod and telescopic sight. The instrument has declination scale with micrometer adjustment, azimuth circle, cross levels, adjustable turntable. Fully calibrated. A precision instrument.
PRICE **£2/19/6**
Packing & Postage: Vic. 6/-; N.S.W., S.A., Tas. 8/6; Q'land., W.A. 11/-.

PRISMATIC ELBOW TELESCOPE

American make with approx. x8 magnification, extra wide field and COMPLETE WITH COLOR FILTERS. Disposals Price £5/-/-.

A limited number of English elbow telescopes approx. x6 magnification, normal field. TO CLEAR, 35/-.

Also a few English Elbow Telescopes, approx. x6 magnification, extra wide field, 11in long, 5in high, eye relief 1in. DISPOSALS PRICE, £3.

Packing & Postage on each of the above. Vic. 6/-; N.S.W., S.A., Tas. 8/6; Q'land., W.A. 11/-.

Send for latest illustrated Bargain Catalogue.

AIRCRAFT BOMB HOIST: Ideal for Garages and Workshops. 187 to 1 reduction gear. Length of hoist, 7ft. *Packing 5/- Freight Forward.* **£6/15/-**

BENDIX LOOP AERIAL, RA 10 FA. Incorporating a rotating mechanism and reduction gear with a 9in. loop.
Packing & Postage: Vic. 6/-; N.S.W., S.A., Tas. 8/6; Q'land., W.A. 11/-. PRICE **15/-**

Ex-Aircraft 8-DAY CLOCKS

Suitable for cars, trucks, or any dashboard panel. Made by Smith of England, these are ex-aircraft 8-day clocks with 2¼in face.
PRICE **£5**
Packing & Postage: Vic, 4/6, N.S.W., S.A., Tas. 5/9, Q'land., W.A. 6/3.

SPECIAL QUOTES FOR LARGE QUANTITIES

WALTHAM TRADING CO.
319-321 SWANSTON ST., MELBOURNE

Please address all correspondence to Box 5234, G.P.O., Melb.

GENERATORS

For Light and Power Plants

12v.	500w.	£5/-/-
12v.	750w.	£10/-/-
24v.	500w.	£11/15/-
24v.	1000w.	£12/15/-
24v.	1500w.	£15/15/-
30v.	100 amp	£30/-/-

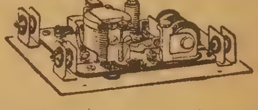
The 24v. models can be operated as 32v. without alteration.
Packing 5/-. Freight forward.

12v. Automatic Cut-Out suitable for above units 15/-
Packing & Postage: Vic. 3/6; N.S.W., S.A., Tas. 4/-; Q'land., W.A. 4/6.

50-0-50 Amp Meter, 2¼in dial, also to suit above equipment £2/10/-
Packing & Postage: Vic. 3/6; N.S.W., S.A., Tas. 4/-; Q'land., W.A. 4/6.

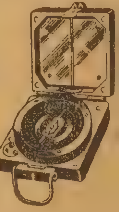
3½in. V Pulleys, splined to fit Generator Shaft . £1/15/-
Packing & Postage: Vic. 3/6; N.S.W., S.A., Tas. 4/-; Q'land., W.A. 4/6.

REGULATOR & CUT-OUT



Suitable for use with 24v or 32v. Generators, or as tractor spare. Made by Bendix of USA. Price **£4/19/6**
Packing & Postage: Vic. 5/-; N.S.W., S.A., Tas. 7/-; W.A., Q'land 8/6.
Do not include Packing & Postage on Cut-Out or V. Pulleys if ordered with Generators.

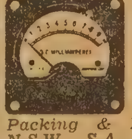
HIKING COMPASS



A practical compass in a bakelite case 2½in x 2½in with thumb ring. Calibrated with luminous markings for night use. Invaluable for hikers.
PRICE,
£1/9/6
Packing & Postage: Vic. 4/-; N.S.W., S.A., Tas. 5/-; Q'land., W.A. 5/6.

COMPASS TYPE P.4.

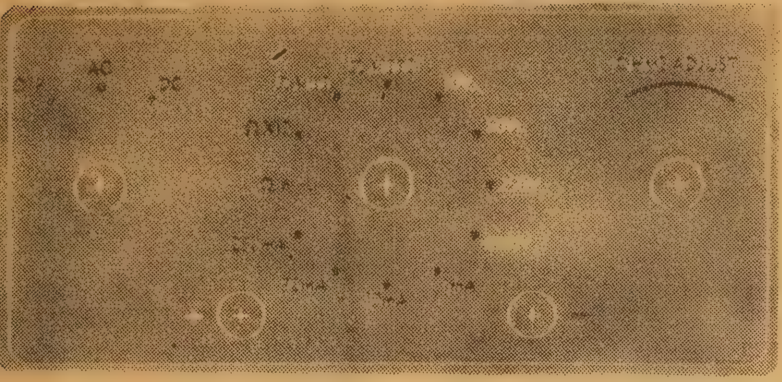
A large navigational compass, 7 inches dia. x 3½ inches deep. Spring mounted with adjustable circle calibrated in degrees. This is a liquid-filled compass originally a pilot type, but can be used for all types of small sea craft.
ALL RECONDITIONED AS NEW.
Price **£4/10/-**
Postage & Packing: Vic. 6/-. N.S.W., S.A., Tas. 8/6, Q'land W.A. 11/-.



MILLIAMP METERS

0 to 1 Milliamp Meters, 2in Moving Coil Type.
£1/7/6
Packing & Postage: Vic. 4/-, N.S.W., S.A., Tas. 5/-, Q'land., W.A. 5/6.

PANELS FOR R & H EQUIPMENT



A SERVICE of great value to home constructors is available from ngus and Coote, of 500 George St., ydney. They are now in a position supply all types of nameplates, ales, panels, &c in a wide variety finishes. Bright and satin chrome, ight and satin nickel, brass either lished or burnished, are included. erspex or black bakelite can also engraved and, in addition, they ave available a multi-colored lam- ated plastic material. When en- aved, the letters are seen in the lor of the layers under the surface.

Having had experience in this eld, Angus and Coote have avail- le templates for most of the stan- ard radio and electrical symbols d, if ordering special panels by tter, it is normally only necessary supply a hand-drawn diagram showing exact positions of control shafts, terminals, &c, and approximate positions of the lettering.

Where switches are involved, it is necessary to mention the angle between positions, and in respect to vertical.

An excellent example of their work is a panel for the R & H multimeter, finished in satin nickel. It is available from stock at 13/- or 14/6 posted.

NOVAL SOCKETS FROM TELETRON

A NEW line of noval sockets is available from Teletron. Type T19-G is suitable for broadcast and ost shortwave applications and is oulded from black plastic material. cases where the very best of in- lation is required, the ST19-0 is ost suitable, being moulded from mica filled plastic.

Both the contacts and the earthing igot are fabricated from silver- ated material ensuring easy-to- ake solder joints and good con- ctions between the pins of the lve and the contacts of the socket.

Care has been taken with the de- gn of the moulding to ensure that e contacts have sufficient freedom movement to obviate the possi- lity of straining the valve pins but, the same time, to allow the valve be plugged in in a positive fashion.

The price is 1/3 in the case of the T19-G and 1/9 in the case of the T19-0.

NEW RA OUTPU

THE 6BV7 is a ature valve de for the output stag ceivers. It include power-output pentode a elements in the one env

Thus a typical small superhetrodyne would use a 6AE8 converter, 6BA6 IF amplifier, 6BV7 detector and output stage and a 6X4 rectifier. The overall gain of such a receiver is quite high, allowing a worthwhile amount of negative feedback to be applied if required.

With 250 volts HT, the 6BV7 will deliver 4 watts into a 7000 ohm load. With the same load and 180 volts HT it will deliver 2 watts, under which condition an input of only 2.6 volts RMS will give the full rated output.

The list price of the 6BV7 is 19/6.

IMPROVE THE EFFICIENCY

of your business with an Electronic Multimeter and Probe incorporating Vacuum Tube Voltmeter and Decibel Meter.

Specialising in Electronic Multimeters and VTVM's, R.E.L. has developed an instrument of high quality, dependability, accuracy and versatility, simple to operate, and selling at the most reasonable price possible.

This attractive 32 range instrument is fully guaranteed, and measures resistance from 0.2 ohms to 1000 megohms in five steps, D.C. voltage from 0.1 volt to 1,800 volts in ten steps, A.C. voltage between 20 cycles and U.H.F. Spectrum from 0.1 volt to 600 volts with internal diode or external probe.

The decibel range is from —18db. to +5db., and from +2db. to +25db.
The imput impedance is 10 megohms and up to 30 megohms on the D.C. x 3 ranges.
Write for information.

Available from — in Sydney.
R.E.L., 107 Parramatta Rd., Haberfield.
Price's Radio, 5-6 Angel Place, Sydney.
U.R.D., 175 Phillip Street, Sydney.
In New Zealand—All Branches of Turnbull and Jones Ltd.

ROBINSON ELECTRONIC Laboratories

Telephone UA 1154

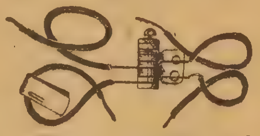
REL

107 PARRAMATTA ROAD. HABERFIELD N.S.W.
NEAR LIVERPOOL ROAD. RING, WRITE OR CALL FOR INFORMATION.

SPEAKER BOXES

ractive metal boxes with louvre ont will take up to 7in speakers, uitable to hang on wall or use on table. Easily worth 35/-.

Our price 18/9

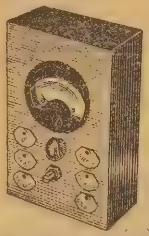


METAL RECTIFIERS

U.S. ARMY

Full wave 1mA Rectifiers will work successfully on 5mA, extremely small physical size, brand new, easily worth 35/-.

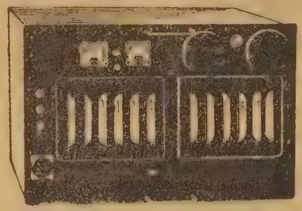
Our price, 17/6 each.



CHIEFTAIN MULTIMETER

The ideal pocket size meter for measuring voltages of electrical circuits and checking continuity of circuits etc., volt scales 0-15, 0-150, 0-300, 0-600. D.C. Ohms scale 0-50,000. The cheapest and smallest on the market, complete with prods and battery, can be carried in your coat pocket with ease.

Price, £3/9/6



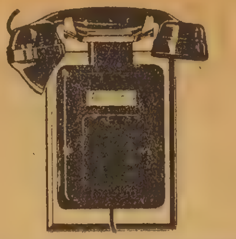
AT300 TRANSMITTERS

Radar Transmitter uses the following parts:—2-AV11 Valves, 2-Cyclatron Valves, 2-4 Ceramic Socket, 1-24 Volt Motor, 2-.01-5,000 Volt Working Condenser, 1-.02-10,000 Volt Working Condenser, 1-.001-5,000 Volt Mica Condenser, 3-Heavy Duty Transformers, 1-0-100 Volt A.C. Meter which is 0-1 mA movement with 1mA dry metal rectifier fitted. 1-0-5 mA D.C. Meter and many other parts such as stand off insulators, coils, etc., easily worth £20.

Our price, £4/19/6

NOTICE

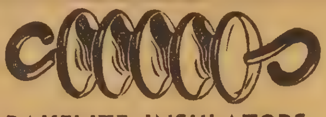
All parcels sent registered post unless otherwise stated. Postage or freight must be included with order.



SPEAK EASY TELEPHONES

All black bakelite with hand set as illustrated. Most efficient and neat in appearance. The buzzer method of calling is employed and results are particularly good. Usual price £8/10/- each.

Our price, £5/12/- each.



BAKELITE INSULATORS

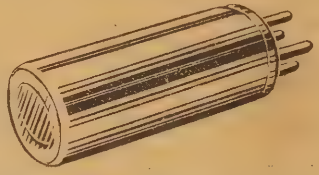
Highly efficient ex-disposals Insulators with brass hooks in ends, suitable for any outdoor aerial. Worth 1/3 each.

Our price, 6d.

PORCELAIN EGG INSULATORS

Standard type glazed white porcelain. Worth 10d each.

Our price, 6d.



English 12 volt 4 pin SYNCHRONOUS VIBRATORS

brand new and perfect, spun aluminium can and rubber base are features of this job which will replace any standard Australian type 12 volt 4 pin Vibrator. Worth 30/-.

Our price, 15/9

SPECIALS SPECIALS

OUTPUT TRANSFORMERS

Heavy duty type 6600 C.T. input to 500 ohm line approximately 30 watts. Worth 68/-.

Our price 32/6

MAGNETO COILS

As used on aircraft engines. A few only left. These have pimary and secondary windings wound on laminated iron core and have a mica condenser across primary. May be suitable for oscilloscopes and ignition on motor engines. **Price 4/- ea.**

METAL CABINETS

Finished in mottled cream and fawn, very attractive, sizes 14 x 7 x 6¾ and 11 x 7 x 7. Worth 30/- each.

Our price to clear 11/9 each.

Instruction Manual for Army Wireless Set No. 208.. Each .. 1/-

.0001 Silver Mica Condensers. Usual price 1/3. **Our price, 6d ea. or 4/- doz.**

Relays as used in AR8,-AT5 Equipment. Worth 25/-. **Our price 6/6 each.**

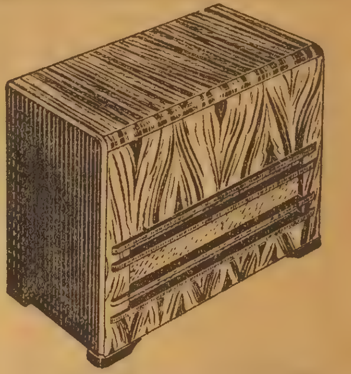
Low Tension Air core chokes, suitable for filtering low tension supply in car radios, etc. excellent job worth 4/6.

Our price .... 2/- each.

REMOTE CABLES

As used on 108 Transceivers, an excellent control that can be used on car radios etc.

Price with knob, 1/- each.



RADIOGRAM CABINET

As illustrated. Specially selected walnut veneers are used in the construction of this full sized radiogram cabinet. Any standard sized chassis and any record changer or single unit motor can readily be fitted. Panels are uncut. Ideal for the home set builder. Worth 21 guineas.

Our price, 15 gns.

WIRE

1/.028 Nylex wire assorted colors suitable for bells, indoor aerial etc. in random lengths.

Price per 100 yds. 8/9 or 2d per yd.

Shielded Belden Hook-up wire, outside covering lacquered woven cotton. Ideal for car radio work and microphone cables etc. Easily worth 2/- yd.

Our price .. .. 9d. yd.

AERIAL WIRE

Water-proofed outdoor aerial wire 50ft coils boxed. Usual price 5/-.

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100ft. coils Aerial wire. Usual price 6/6

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Special prices for quantity.

PUSH BACK WIRE

Available in 6 colours. This is a well-known make of English wire, ideal for radio set wiring and many other uses. In 100 yard rolls. The normal price is 6d. yard.

Our price 30/- per 100 yards.

5 CORE CABLE

Each core a different colour and rubber covered. Complete cable is enclosed in black woven cotton coated with lacquer. Ideal for battery cables, speaker extensions etc.

Price .. .. 1/3 yd.

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Two rubber insulated stranded cores of different colours enclosed in woven tinned copper sheath.

Price .. .. 1/3 yd.

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TYPICAL ELECTROFLASH PARTS NOW AVAI

FOUR COMPONENTS FROM NOVA

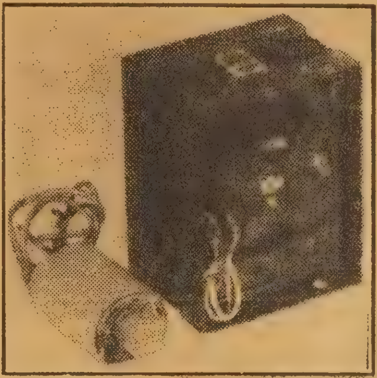
Nova Electrical and Engineering Co. announce that they have stocks of four vital components for use in electronic flash units and which are shown in the accompanying photographs.

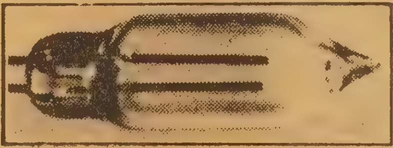
'HE first of these is the reflector, a very important unit, which ight normally be difficult to ob- in, being a non-standard item. This e is made from aluminium, spun the required shape, and finished

ith an anodised reflecting surface d black brocade elsewhere.

Anodised aluminium provides an cellent reflecting surface and has e further advantages of being relave cheap and free from the tenncy to tarnish, a serious disadvange with many other surfaces. Test in conjunction with our own unit, proved to be as efficient as any e have tried and would seem to be eally suited to this class of work.

The neon lamp is a miniature type, ideally suited for use in confined spaces, and measures only ¾" long by ¼" diameter. It is supplied without a base or limiting resistor, being easily mounted in a standard rubber grommet and wired directly into the circuit. The absence of a limiting resistor is an advantage where there is already sufficient resistance in the supply circuit to protect the lamp and where additional resistance might prove inconvenient.





The two transformers shown are the HT transformer (on the right), and the trigger transformer. The HT transformer is designed to operate from a standard vibrator circuit with an input voltage of 5.2, and to deliver a secondary voltage of 1100. A primary tapping is also provided at 4 volts to enable the small accumulator to be used if preferred.

TCC & UCC
CAPACITOR

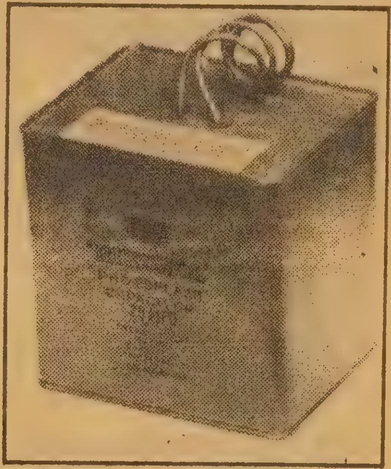
THE United Capacitor Co.
have available three ca specially designed for phot work, two English-made TCC b and one Australian UCC brand.

The TCC types are the HK33 an the HK28, the latter being illustrated below, and have capacities of 33 mfd and 28 mfd respectively. Both are rated at 2500 volts intermittent, under which conditions the HK33 will deliver 100 joules, while the HK28 will give 87 joules. When operated at 2000 volts the ratings are reduced to 66 joules and 56 joules.

The UC capacitor is rated at 18 mfd and 2500 volts intermittent rating, and will deliver 56 joules at the full voltage rating, and approximately 35 joules at 2000 volts.

All types are of similar construction, being substantial metal cans with rolled seams and having heavily insulated leads passing through rubber insulators in the top of the can.

UCC also have stocks of .1 mfd, 1500-volt capacitors as used in the voltage doubler circuit, as well as miniature 350-volt types in various capacities.



STC HT RECTIFIERS

TANDARD Telephones and Cables Pty. Ltd. are agents for the SenTerCel" rectifiers as used in e original Electro-Flash. The two pes available which are suitable for

is circuit are the type K2/50 and e N2/50, both of which are idencal electrically but have different rminal arrangements.

In the case of the K2/50, as illusated, the connections are made by eans of pigtails, while the N2/50 fitted with screw terminals. imensions, excluding terminals, are pproximately 3 5-8in long by 5-16in iameter.

Ferguson HT & Trigger Transformers

A WIDE range of photo-flash transformers is available from Fergusons Transformers Pty. Ltd., and three of these, the HT118, HT119, and the HT120, are of particular interest to Radio and Hobbies readers.

The HT118, the larger one in the accompanying photograph, is designed to deliver 1100 volts from an input of 5.2 volts in a conventional vibrator circuit. The HT120 is a similar design, but has an additional primary tapping at 4 volts to permit use with either dry cells or accumulator.

The HT119 is the trigger transformer, also shown in the photograph, and is designed to deliver a peak voltage of 4000 volts when a condenser charged to approximately 250 volts is discharged through the primary. As will be seen from the photograph, this unit is fitted with mounting feet, a feature which assists materially in assembling it into the gun.

All the above types have been tested in our original circuit and found to give excellent performance.

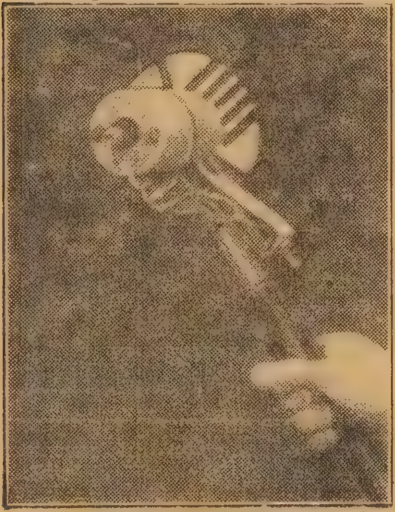
ELECTRIC HEDGE TRIMMER

ds of blower motors, from ex-disposals radar sets, have passed into the hands of radio enthusiasts. This article, reprinted by arrangement with an English magazine describes how this type of motor can be converted into a hedge or lawn trimmer.

RIVET hedge trimming is always a tedious job, and, if the hedge happens to be a long one many hours' work is necessary to keep the hedge in good shape during the summer.

The electric hedge-trimmer, as shown in fig. 1, is easy to construct, and if made from ex-government materials may be built for less than the cost of a good pair of hand shears.

During two years' use on our rather extensive hedge, the trimmer has worked very well and saved a considerable amount of time and energy. After dismantling for photographing and oiling, the machine is stil good for many year's service.



The completed hedge trimmer ready for use.

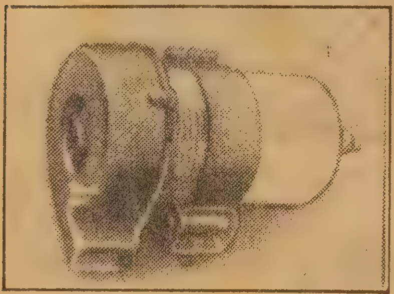
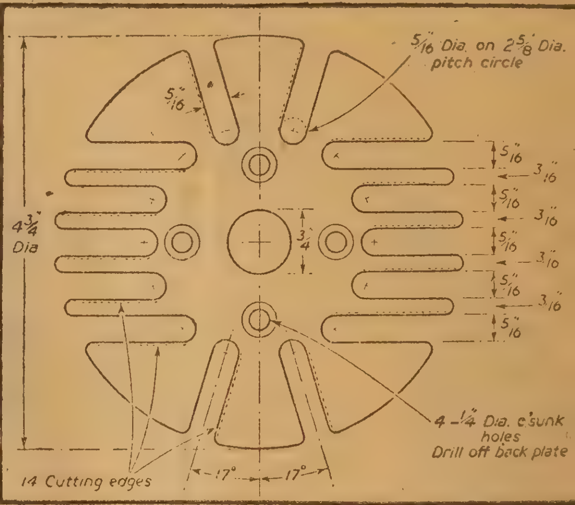


Fig 2. The blower unit before conversion.

Fig. 4. The dimensions of the toothed cutting disc.



The following instructions and dimensions are for converting a 24-volt blower. When purchasing a blower make sure fan revolves freely, or have it tested.

Dismantle the blower casing and remove the fan, then wire the motor temporarily and run to check direction of rotation. If opposite to that indicated in fig. 5, check the wires and reverse the direction of the current in the armature A and B (fig. 3).

The circular disc is marked out on a piece of 10 or 12-gauge mild steel sheet (fig. 4). Cut out the 4¾in diameter, drill and countersink the ¼in diameter holes, using the backplate from the blower as a drilling jig for spacing, &c. Drill the 5-16in diameter holes and cut out the slots with a hacksaw; dress off, smooth and file a radius on the ends of the teeth.

ASSEMBLY

Sharpen the cutting edges about 2 degrees where marked. This disc may now be assembled to the motor, using the original four countersunk screws. If the heads protrude, countersink until they are flush.

The cutter should now be marked out on 14 or 16-gauge mild steel. A piece of stainless steel would be better if available (fig. 5). Drill a ¼in diameter hole in the centre, cut out or grind to shape, and sharpen the edges about 2 degrees where marked.

Fasten the fan to the cutter with a ¼in nut and bolt, and mark off the shape to be cut away; detach, and cut to shape with a hacksaw, leaving a boss in the centre 7-16in high. Fit together with th ½in bolt and drill the 1-8in diamete rivet holes on a 2in pitchcircle.

Rivet together with countersun rivets on the back face and file o flat. The cutter may now be mounted in position, but it is advisable t replace the existing grub screws wit setscrews.

This facilitates easy removal fo adjustment, and flats should be file on the motor spindle to suit.

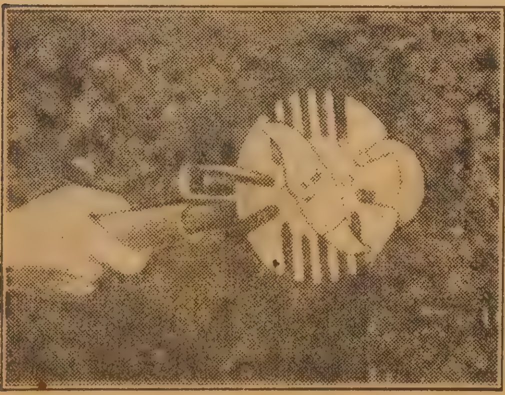


Fig. 1. The cutting side of the trimmer, showing the shaped cutter blade.

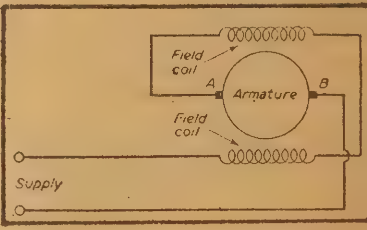


Fig. 3. Circuit diagram.

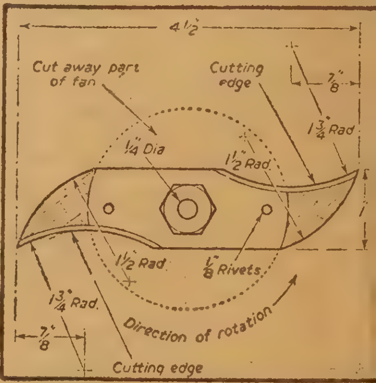


Fig. 5. How to mark out the shape of the steel utter.

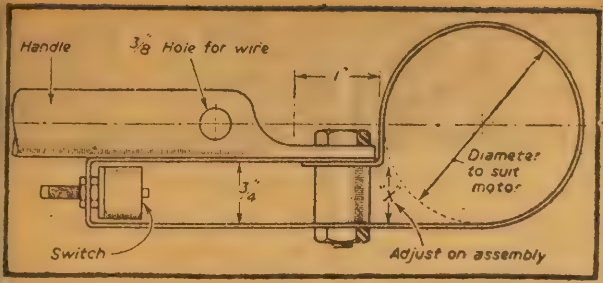


Fig. 6. Details of the clip and switch holder.

Set the blades as close to the disc possible, bending the disc blades ghtly if necessary. The gap must the same in any position, the cutg edges meeting in a similar manr to a pair of shears. To prevent y chance of the cutter coming off, ll a 3-32in diameter hole through shaft and boss and insert a split 1.

The handle is made from a piece ¾in diameter steel or aluminium be 8½in long. Swage the end for a tance of 1in, round off, and drill ¼in diameter hole 5-16in from the aged end. Drill a 3-8in diameter le 1¾in from the swaged end for wire to pass through and remove burrs.

Fit a 7in length of ¾in diameter se to provide a good grip, and allow rubber to protrude below the el to make sure the electric wire ll not chafe.

The clip and switch holder may be nt from a piece of 18-gauge alunium or duralumin, 1in wide and ½in long (fig. 6). Bend to shape in a e and around the motor or a circar object about 2 1-8in diameter, n mark off the holes and drill for bolt and switch.

Assemble on the motor with a ¼in t 1in long; nip up tight and meae for the distance marked x. Cut distance-piece from 3-8in or ½in meter tube and adjust this as reired to hold the motor and handle urely at any desired angle.

Assemble the handle, clip and itch complete to the rest of the chine, and the trimmer is ready wiring.

The motor being series wound will ve one wire from the fields and one m a brush. Pass the wires through handle, breaking one wire at the itch; fit a two-pin plug (or a type t used in the home to prevent accintal use on a high voltage).

Use a flexible twin-rubber cable about 3 amps, which can be plugd in to a transformer at approxitely 35 to 45 volts AC, or if DC current is available. 25 to 35 volts will be suitable. This overrunning is necessary to obtain sufficient power with a light weight.

It is not advisa mer from an a through a 450-w cause when cutt there would be dan shock.

The machine is us sweeping movement, t ting plate slightly in th the cut. The comb gathe straggling ends, leaving trimmed hedge.

The trimmer can be used to c grass and the edges of the law care must be taken to make stones are not gathered by the b Always dry the machine after u

---

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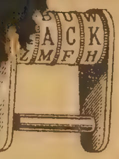

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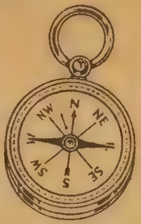

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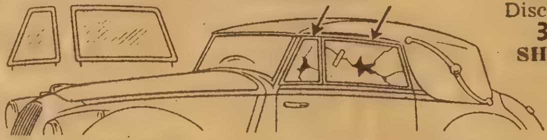

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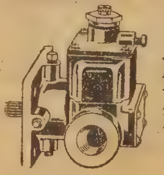

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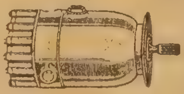

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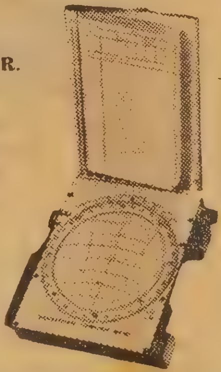

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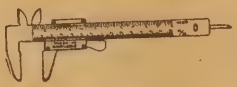

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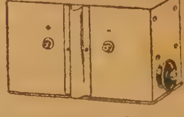

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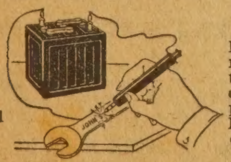

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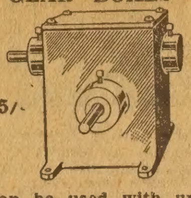

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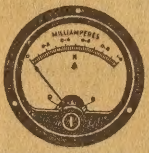

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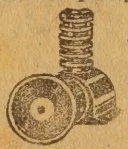
Eng. 0-500 Micro Ampmeter M/coil	37/6
Eng. 0-150 Ampmeters 3½in Dial AC-DC	84/-
Eng. 0-50 volts 3½in Dial AC-DC	75/-

BRAND NEW AIR COMPRESSOR

2.2 cubic feet. will pump up to 75lb.

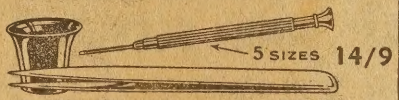
Never before at this price Ideal for Spraying



£11/15/-

Will work off ¼hp Motor.

WATCHMAKERS AND INSTRUMENT MAKERS



14/9

English Tweezers	6/6 and 5/6
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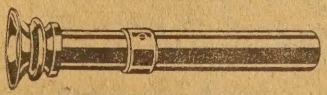
ARMY FOCUSING TELESCOPE

Easily converted for use on dumpy levels.
Can be used as a rifle sight.
Excellent magnification £4/19/6

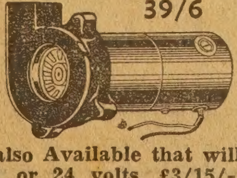


ADJUSTABLE FOCUS.

ENGLISH MOTOR AND BLOWER, 24 VOLTS

39/6

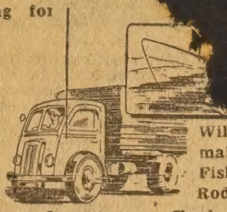
Will Work off 32-volt Lighting Plants.



Larger size also Available that will work off 12 or 24 volts, £3/15/-.

STEEL ARMY T RODS WILL MA RADIO AERIALS OR TRUC

Too long for postage, advise nearest Railway Station

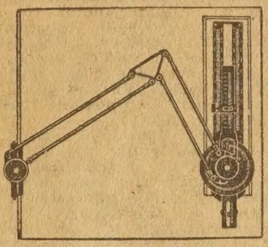


Base to suit Aerial. 9/6 EACH.

Will al make id Fishing Rods.

12ft long. 3 sections. Each section 4ft 25/-. 8ft long, 2 section, 15/-

R.A.F. PLOTTING BOARD WITH ARM

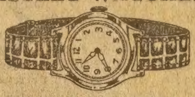


Bakelite Base. Draws Angles Parallel or Vertical.

70/-

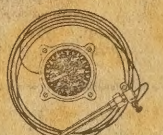
IDEAL FOR ENGINEERS, STUDENTS, ETC.

How is this for Value: GENUINE SWISS GENTS' WRISTLET WATCHES



Genuine Leather Wrist Strap, 79/6. Expanding Chrome Band. American Style. £4/4/-.

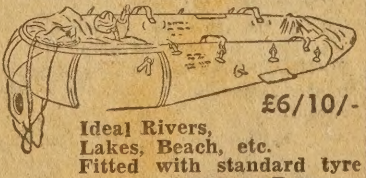
BRAND NEW REMOTE CONTROL TEMPERATURE GAUGES



37/6

Ideal for cars, tractors, boats, ovens etc. Never before at this price

R.A.A.F. RUBBER DINGHIES



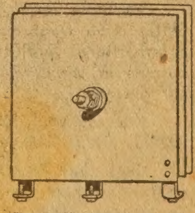
£6/10/-

Ideal Rivers, Lakes, Beach, etc. Fitted with standard tyre connection for use with CAR Pump. Invaluable for flooded areas.

BRAND NEW ENGLISH RECTIFIERS

Make yourself a Battery Charger.

12v.	2 amp	35/-
6v.	5 amp	45/-
12v.	5 amp	72/-
6v.	2 amp	24/6
12v.	3 amp	45/-



6 volt 4 amp, 39/6. Transformers to su above Rectifiers. 2 amp, 37/6. volt 5 amp. 45/- 12 volt 5 amp 57

WERS TO CORRESPONDENTS

e Bay, NSW) sends along de- /W superhet tuner featuring broad-band response on the band, magic eye tuning and follower output.

It is obvious that some work went the preparation of your circuit des- E.R., and no doubt the results are atifying. We presume that your tests n Q reduction were made with standard commercially-available transformers and coils. The figures you mention seem to be consistent with this line of thinking. We feel, however, that there is a lot to be said for the simpler approach to broad-band response made in the True Wide-Band AM Tuner described in the August, 1952 issue. Another point, too, is that this latter tuner would probably have a flatter top and steeper skirts to the response curve, one of the very points on which it shines over the TRF with resistive-loaded circuits. We are filing your circuit, however, for possible use in the Reader Built It page.

B.A.H. (East Coburg, Vic.) is following the Learn While You Build It series and has progressed as far as the "Reflex Two." While all the earlier sets have worked satisfactority, he has struck trouble with this one, being only able to receive very faint signals from one station.

A.: As far as we can judge from what you are able to tell us, B.A.H., it would seem that the "front" end of the set is not operating at all and that only the second tuned circuit, the diode detector, and perhaps the triode section of the 6AR7, together with the 6V6 and associated circuits is functioning correctly. This would make the set perform something like a crystal set followed by a 6V6 and having a very inefficient aerial connection. Components most likely to contribute to such a condition would be the coil with a possible open circuit, particularly in the secondary winding, the trimmer condenser with a short circuit, the 100 pf condenser C1, or any of the wiring associated with these components. It would also be possible for the primary of the RF coil to be open circuited, which would mean no voltage on the plate of the 6AR7, thus completely killing any RF amplification but allowing it to operate as an audio amplifier by virtue of the triode connection. We suggest that, if you check these points, you will stand a fair chance of finding the trouble. If you are not successful it might be worth while enlisting the aid of someone with a little more experience. A direct equivalent of the 6AR7 would not be required for the type of set you have in mind and we have several such circuits on our files which we could supply through postal service.

B.I. (Ashgrove, Qld.) sends a contribution to the Reader Built It page and also tells of the various R & H sets which he has constructed, comments on the proposed Amplifier Handbook and makes a few suggestions for the improvement of the magazine.

A.: Many thanks for your contribution, B.I., and it has been passed on to the appropriate section for possible use at a future date. Many thanks also for your comments about the handbook and Radio and Hobbies, and your suggestions, the latter being something we are always pleased to receive from readers in order that we may know the type of articles which are most popular.

J.B.A. (Moonah, Tas.) forwards a contribution to cover a previous inquiry and makes some additional comment on constructional details for an electric soldering iron. He also raises a point about the performance of the Slumber Set.

A.: Many thanks for your contribution J.B.A., which has been forwarded to the appropriate department. We appreciate your comments regarding the soldering iron, but we still feel that in many cases the correct materials would not be readily available and that many readers would be tempted to substitute unsuitable ones, with the resultant risk of shock. As it is, those who have made the iron have at least some knowledge of the risk involved and, apparently, are careful to take precautions. The failure of the Slumber Set to regenerate properly would certainly limit its performance seriously and we suggest that you make every effort to find the trouble. The most likely cause would probably be reversed connections to the reaction winding or an open circuit winding and, assuming that the valve is being correctly operated with correct voltages, there is not a great deal more that can be suggested as causing trouble in this part of the circuit.

A.H.D. (Kew, Vic.) sends in a suggested method of obtaining push-pull operation without the customary phase chan and asks us to comment on the idea.

A.: As your friend suggests, A.H. the idea is not a new one, but has ne been really popular, due to several limi tions. First, however, it might be well to say something about the ph inverters. There is no reason why well-designed phase inverter should give an output as accurately balan as a transformer, or even better if c is taken in the selection of componen A transformer cannot always be rega ed as automatically perfect and wo only be made to certain tolerances, with any other component. It must a be realised that the degree of unbala which can be tolerated in any such s tem is largely dependent on the con tions under which it will be used, most serious effects of this conditi only being apparent at full output. the light of these points, the system y suggest has a number of disadvantag the main one being the one you seeking to avoid. Whereas, in most co ventional systems, correct balance c be obtained by simply matching a f fixed resistors, your scheme requires t two potentiometers be correctly match and that the matching be maintained all settings of these coupled units; requirement which would, in practice, prohibitively expensive, to say nothi of the replacement problem, and achie nothing that cannot be done by co ventional means. All things consider we suggest that the phase changer wh we have featured in so many amplifi would be a far better proposition a from our own experience, you may ta it that the balance achieved is all t is required.

R.K.S. (Moculta, SA) wants to conv the filament circuit of his battery ceiver to operate from a 12-volt lighti plant and asks if we can suggest a su able arrangement.

A.: The valve combination is rath unusual, R.K.S., plus the fact that the is more to the design of such netwo than simply supplying the various fi ments with correct voltages, due to t need to maintain correct bias, the fi ment of battery valves forming part the bias circuit. Since it is probable th correct bias is already provided in t original circuit it is important that t condition not be disturbed. The b arrangement, short of a complete design, appears to be to connect all t 2-volt filaments in parallel with the neg tive terminal (pin 7) to the chassis th connect the heater of the 6B7 in ser with this network and finally a resist in series with the 6B7 heater and t supply positive terminal. The heat of the 6B7 will have to shunted with 20 ohm, 3 watt resistor, while the seri resistor will need to be a 6.66 ohm, 3 o watt type. The 20 ohm resistor could replaced with a 6 volt .3 amp dial light two 6 volt .15 amp dial lights if desir The above arrangement will result some waste of power but this is not like to be serious in a lighting plant and w be offset by the convenience of t arrangement.

T.B.S. (Singapore, Malaya) sends alo a circuit of a simple receiver in ca other readers are interested.

A.: Thanks, T.B.S., for your letter. notice that you have no control on generation in the first stage. We pr sume that you intended the plate lo resistor to be made variable in ord to control the plate voltage to the d tector. In this respect, a pentode is mo suitable. The two triodes shown a not easily procurable in Australia a are normally expensive by comparis with other valves. Of course, subs tutes could be used without any chan in results. A further point, too, is th the volume control on the second out to the phones will also act as a "tre cut" tone control as the level to the phon is altered.

E.F.L. (Laughtondale, NSW) has built modified version of the fluorescent lig ing unit but is having trouble wh using it for fluorescent lamps, the cu rent drain appearing to be excessi

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required, must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 3/6. These are available for nearly all our designs.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

gh it is normal when used with
nent lamps.
: The drain you quote certainly does
ear to be excessive and we can only
est that the ballast choke is at
t, since this is the main component
rning the current drain when fluor-
nt tubes are used. The suggestion
the starter is the cause of the ex-
ive d[illegible] or that it causes extra
n, is [illegible]kely one, since the starter
nally [illegible] to draw any current as
as [illegible]e ionises.

C.K. [illegible]ey, NSW) sends along a
rib[illegible] Reader Built It page
ne [illegible]
[illegible] letter, J.C.K.
[illegible]ibution would
[illegible]at particular
[illegible]we are filing
[illegible]rection.

[illegible] writes to tell us
a one-valve receiver using a type
e has built. The set uses plug-in
made from valve bases and covers
broadcast and shortwave.
Thanks for your letter, B.E., and
re very glad to hear of your interest
adio. We described a set using a
19 in Radio and Hobbies some years
and can verify that it is a good per-
er. By the way, you will probably
nterested in our new series entitled,
h Yourself Radio, which started in
month's issue.

K.B. (Gladstone, Qld.) forwards his
cription for a further 12 months and
e same time makes a plea for more
ery-operated equipment to be de-
ed in Radio and Hobbies. He is par-
arly interested in battery-operated
equipment.

: Many thanks for the sub., E.K.B.,
your suggestions regarding the bat-
-operated equipment have been noted.
e are a number of problems in de-
ng battery operated counterparts of
of the instruments you mention but
are by no means insurmountable. If
cient interest is shown we may be
to devote some space to the subject.

H.C. (Nutgrove, Qld.) sends in a circuit
the Reader Built It section and wants
now what knowledge would be re-
ed to sit for his Amateur Operator's
ket."

: Seeing that you have been through
rrespondence course and have studied
ARRL handbook, we would think that
theory would just about be equal
e task. You would need to go through
VHF chapters, however, to round
gs off. Regarding regulations, exam-
on times, &c., we suggest you write
e Wireless Branch at Brisbane GPO
request all available information
should be able to supply also the
ent handbook of regulations covering
ation of amateur stations.

D.H. (Christchurch, New Zealand)
ards his renewal of subscription and
a brief outline of his pleasing re-
with the Playmaster Junior Ampli-
and the Playmaster Control Unit No.

: Thanks for your subscription re-
al, E.D.H. We have passed it on to
app[illegible]priate department from which
w[illegible]receive the official receipt and
[illegible] issues involved. We are
[illegible] note your success with the
[illegible] Junior, particularly in view
[illegible]evious experience. If you
[illegible]encounter any trouble from
ta[illegible]mble we would suggest that
turn [illegible] page fifty-three of the Sep-
ber, 1951, issue, wherein some ideas
given for its elimination. From the fig-
given in your letter, it would cer-
y appear that purchase prices are
r in New Zealand than in Australia.
regard to wide-range tuners, we feel
you will be interested in the one
ribed in the August, 1952, issue.

E.K. (South Perth, WA), and others,
been inquiring about circuits for
er-Muller counters as used to dis-
r radio-active minerals.
: We regret that we have no con-
tional details available for such de-
but we understand that a very com-
ensive pamphlet entitled Radio-
ve Mineral Deposits is available from
Bureau of Mineral Resources, Chan-
House, 485 Bourke St., Melbourne.
this details a number of tests which
be conducted by prospectors who sus-
that they have radio-active minerals
heir possession.

Continued on next page

FILTERS AND 2-OHM VOICE [illegible]

(Continued from Page 93)

The procedure is illustrated in the accompanying diagram. The amplifier is fitted with a standard 15-ohm, rather than a 2-ohm, output transformer and this is coupled through the voice coil filter to the outer leads of the auto-transformer. The 2-ohm leads are connected in turn to the speaker voice coil.

This system is perfectly practical and, provided a suitable auto- transformer is used, it does not make any difference to the audible results. And it is certainly preferable to putting up with the distortion problems mentioned earlier. The obvious difficulty is that it involves the unexpected use of a 15-ohm rather than a 2-ohm output transformer.

ALTERNATIVE IDEA

Where a 2-ohm output transformer is already on hand, a less desirable but perfectly workable scheme would be to connect the two auto-transformers in series with the voice coil line, with the filter in between. We have not tried this arrangement but it is mentioned for the sake of those who may like to experiment.

Tests have shown that 15 to 2-ohm auto-transformers do not greatly affect the final results and they can, if necessary, be hand-made.

By way of example, we obtained a standard speaker transformer with a ¾in square centre leg. The original faulty winding was removed and a new winding installed in its place. This was layer wound with 19 B & S enamel, insulated with notepaper between layers. It had 137 turns in all tapped at 50 turns for 2-ohm voice coils and 100 turns for 8-ohm voice coils. (The 8-ohm tapping is of no immediate interest.)

Tests on this transformer showed it to be 88 pc efficient at 1000 cps. Its response at medium power was within a fraction of one db between 30 and 5000 cps, being down just over 1 db at 10 Kc and 1.5 db at 15 Kc.

Most apparent limitation, as expected, was the power handling capacity at the low frequency end. This was about 6.5 watts at 50 cps and 3.9 watts at 30 cps—both figures indicating the beginning of waveform break-up.

By winding the same number of turns on a small powe[illegible] core and increasing the [illegible] to fill the available wind[illegible] still better figures could be [illegible] such that the effect of th[illegible] transformer on response and [illegible] would be difficult to measure [illegible] certainly impossible to hear.

Other ideas about the use of th[illegible] 12-OX and similar low impedanc[illegible] speakers may come to light at a later date but the foregoing will provide ample food for thought and experiment in the meantime.

No mention has been made of the low frequency characteristics of the speaker but those do not lead to any immediate problems. It is sufficient to suggest that, for best results at the low frequency end, the speaker be mounted in a vented enclosure. Design data has been given for such enclosures on a number of occasions and specific recommendations have also been made by the manufacturer.

MORE ABOUT THE ELECTRO FLASH

(Continued from Page 90)

most of them borrowed from our parent company's camera store, but we finally decided that one of the most efficient was a commercial unit which should be readily available from our advertisers by the time this is published. This is a bowl shaped, spun aluminium unit, having an anodised reflecting surface and finished in black brocade on the outside.

Anodised aluminium is regarded as one of the most efficient reflecting surfaces, with the possible exception of silver which, however, tarnishes easily. Chromium appears to be one of the poorest. Considering the relative cost, plus the stability of the surface, it would appear that the anodised aluminium is a reasonable compromise of all factors.

Next month we hope to be able to report on the performance of D76 developer for this class of work, describe a contact device for simple type shutters, discuss the use of accumulators in place of dry batteries, and describe the methods adopted to synchronise the flash with high speed phenomena.

A COURSE IN TELEVISION

(Continued from Page 53)

short colored dashes which overlap each other about 50 pc. Lines 1, 3, 5, &c., are scanned in the first field. Then the even-numbered lines are scanned, with the dots so displaced as to fall halfway between those of the same color in the line above them. The odd and even lines are again scanned in the third and fourth fields, with the dots filling in the spaces left in the first and second scannings.

Four fields are required for a complete picture, instead of two as in black-and-white. Thus there are 15 pictures per second.

However, the interlace pattern is such that there is no danger of flicker, while the dot pattern is sufficiently fine as almost to overcome completely the effect of color break-up on rapidly-moving objects.

When the signal is received on a black and white receiver, the sampling synch. signal is completely ignored. The separate red, green and blue video impulses simply add up to produce a varying pattern of light and shade and the result is seen as a monochrome image.

The receiver therefore ignores the dot interlace and the picture is built up on a conventional double interlace pattern.

[illegible]VERS TO [illegible]SPONDENTS

[illegible]e, **WA)** asks for some in- [illegible] an item of disposals equip- [illegible]es details of markings there- [illegible]

[illegible] item which you have is the [illegible]it from a Bendix BC-22i Fre- [illegible] Meter, produced for and used [illegible]y the US Armed Forces during [illegible] War II. Its purpose in the instru- [illegible] was to provide "crystal check" [illegible]nts on the tuning range of the meter [illegible] enable the calibration of the instru- [illegible]ent to be checked, from time to time, against a known standard, this known standard being the carefully manufactured crystal unit itself. Apart from its use in that respect, it can be used in any circuit where a 1000 Kc reference frequency is required.

W.C.B. (Lilsyth, Vic.) advises us of his amended address for forwarding of copies of the magazine and makes mention of his desire to see more articles on vibrators.

A.: Your new address has been noted by the subscription department, W.C.B. We are mindful of the importance of vibrator-operation to the country reader but we try to maintain a proportional relationship between the types of equipment described.

F.S. (West Brunswick, Vic) is interested in tape recorders and wonders if we intend describing a tape recorder in Radio and Hobbies.

A: As you will note from the present series on tape recording, we are interested in the subject. In fact we do intend to examine the constructional aspect as soon as possible but the matter has been delayed by the pressure of other work.

G.I.S. (Taggerty, Vic.) forwards the circuit diagram of an enlarged version of his amateur receiver previously published in the "Reader Built It" section.

A. You certainly enlarged your earlier version of the set, G.I.S. Possibly the need to make up a suitable arrangement of heater circuitry for the 32-volt source tempted you to do this? If course, your incorporation of record play-back with variable compensation plus a full-sized audio amplifier would soon send the valve total up, but, fortunately, being mainly disposals type valves, no undue outlay is involved. We are placing your letter and circuit diagram on the "Reader Built It" file.

K.G. (Melbourne, Vic.) enquires about a new type of recording which may be used with standard equipment but which plays for a longer time than the usual 78 rpm records.

A: It would appear that you refer to the practice of varying the pitch of the grooves in sympathy with the level of the sound. Where the level is low the grooves can be close together without any tendency for one groove to cut into the next but where the recording level is high the spacing must be wider. Before the evolution of the new technique it was necessary to space all the grooves sufficiently wide to allow for the highest amplitude of the whole recording with the result that a great deal of the record surface was virtually wasted. Some attempt was made to improve the playing time by varying the groove spacing manually but this could only be partially successful because of the difficulty of anticipating the peaks. However, the introduction of tape recording has made it possible to overcome the problem electronically. The master recording is first made on tape. It is then fed into a re-recording machine where it passes through two pickup heads. The purpose of the first one is simply to operate the groove spacing mechanism while the second one does the actual re-recording. The spacing between the two heads is just sufficient to allow the groove spacing mechanism time to operate. As the system can be made completely automatic, a considerable increase in playing time can be achieved. As far as we know there have been very few 78 rpm variable-groove records released, coming mainly from continental sources. We believe that it is already a fairly standard practice in the case of microgroove records.

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WANTED TO BUY, SELL OR EXCHAN

FOR SALE: University TST Super-tester, University Output Meter and Speaker, University B.F.O., 160 Kc/s to 32 Mc/s. Excellent condition. Best offer. **2/5027 Sig. D. Flynn, 1ASSU, Paddington.**

FOR SALE: Williamson Amplifier (new), also 78 r.p.m H.M.V. Record Changer. Particulars: **N. Mitchell, 476 Latrobe St., Melbourne. FJ6013.**

FOR SALE: Williamson Builders' OP25/8.4/2.1, £5/10/-, complete power pack, incl. chokes, £7, exc. cond., 1625 valves, brand new, £1 ea. **UY8056.**

FOR SALE: A.R.C. Nine Kit Practical Course, partly assembled, must sell, £25. **14 French St., Maroubra. FJ4246.**

FOR SALE: 136 copies R. & H., 1940-1951. Any offers. **R. Birnie, 19 Isaac Smith St., Kingsford. FF2886.**

FOR SALE: No. 36 Mod. and Power Supply £15. 7AD Mod. Osc. on 144 M/c. £6. 10 cent Metre Signal Gen., £25. Phase Control Unit £2/10/-, also Trans. Chokes and other Radio Parts. **170 Dunning Avenue, Rosebery.**

FOR SALE: 8-watt Amplifier in metal cabinet, as new, £14/10/-. Also 4.5-watt Amplifier, high fidelity. Metal Cabinet, as new, £12/15/-. **T. Stephenson, Coota Rd., Temora.**

SALE: Complete Radio Course, £4/10/-. **A. W. Winter, Cape Borda Lighthouse, Kangaroo Is., S.A.**

SELL: Wavemeter Crystal Calibrator. **Hinckley, Oleander Dve., Ashgrove, Bris.**

SELL: American Microgroove and 78 Recorder. Perfect. See working. Only £45. **FJ2134. Browne, 4 Tucabia St., Coogee.**

SELL: R. & H. complete since Apr., 1945, and others. What offers the lot? **E. Wilson, 54 Eton St., Malvern, S.A.**

SELL: Avo 16 range meter, £6; 3-8 B. & D. drill, £15; Yank Radio Electronics, 2/- each. **F. Rees, 72 McKenzie St., Bendigo, Vic.**

SELL: ¼ h.p. Motor, 240 A.C., 2850 r.p.m. Only had 10 hrs.' use, £10. **J. Sutherland, Minnipa, West Coast, S.A.**

SELL: Rothermel Crystal Pick-up. Wanted: V.C.T. Please ring **UJ4310.**

SELL: Marconi B28 Receiver, £20. Needs overhaul. Xmitter parts, 7020 Xtal and 5R4GY Rectifiers cheap. Apply **Clark, 13 French Avenue, Bankstown.**

SELL: No. 11 Transceiver, new, inc.
Motors, etc. Best offer. **R. Go**
worthy, I Wippa Court, Jordanville,

SELL: Paton VCT2 Valve, Circ. Te
used few times only, £35. **11 Burw**
Avenue, E'Haw, Vic. WA2676.

SELL: "Hanovia" quartz [illegible] lamp, co
trans., goggles, instruc[illegible]s manuals.
£21. ACOS GP12 PU, un[illegible]ed. £3. R
G12 permag. in metal c[illegible] as new, 9/
S & S, 500/8 ohm[illegible]
each. **D. Jam[illegible]**
Melbourne.

SELL: Dual [illegible]
complete [illegible]
put meter, A[illegible] as new. [illegible]
ternal speaker, [illegible] **A. Murdoch, Edwar**
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(Continued from Page 37)

charge the coupling condenser and obviate the possibility of a discharge through the phones when they are plugged in for the first time.

Either of the above methods is desirable when connecting headphones to any receiver, except perhaps a crystal set. However, we sometimes omit the coupling device in small sets designed for beginners, in order to make them as simple as possible.

So far we have not mentioned the case where the output valve of the receiver is capable of delivering more power than the phones can safely handle. Usually such a set is designed primarily for operation with a loudspeaker and the phones are merely an accessory to help when conditions are difficult, or to avoid disturbing other people near the receiving position.

Sometimes it is convenient to connect the phones to the plate circuit of one of the valves preceding the output stage, arranging the circuit so that, when the phones are plugged in, the drive to the output stage is disconnected. Thus the speake
effectively silenced and [illegible]pho
are connected to a circuit [illegible]
of delivering sufficient [illegible]
damage the phones.

Further, the gain provi[illegible]
output valve, which is [illegible]
excess of that required [illegible]
the circuit.

Another solution to the prob
of connecting headphones to a
ceiver, and one which we have fo
convenient in some Radio and H
bies designs, is to operate the pho
across a resistor connected in
plate circuit of the valve. A bloc
condenser and bleed resistor sho
be connected as described previo
for the circuit using the choke.
point about the arrangement is
a small value load resistor is
in place of the choke.

The aim of the designer is to
portion the value of the resisto
such a value that the power develo
across it is incapable of causing d
age to the phones—or your eardr
for that matter!